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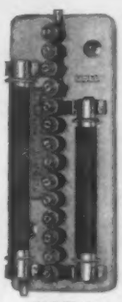

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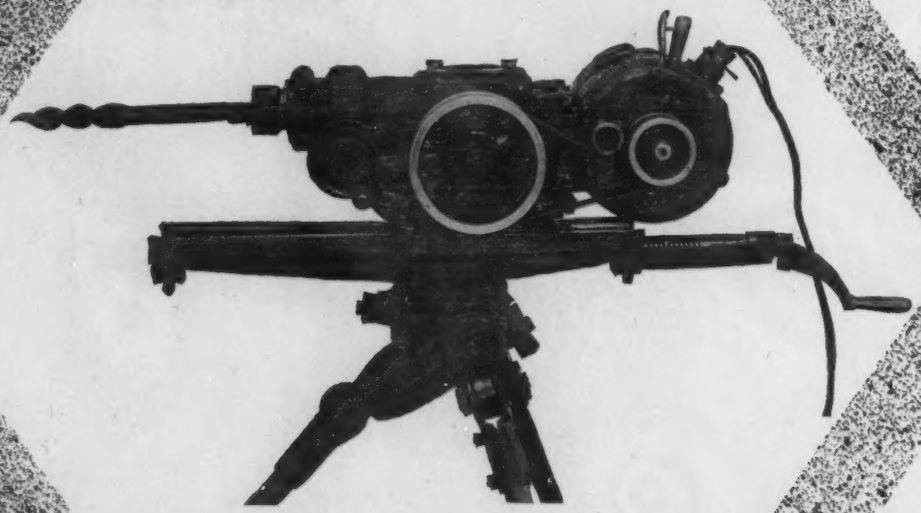

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TRINITY MINE HYDRO-ELECTRIC PLANT

BY J. W. SWAREN

The Trinity Gold Mining and Reduction Company have recently completed a hydroelectric plant remarkable for its simplicity. It was installed to supply power and light to the mill and cyanide plant erected by the same company. The engineering features are those incident to a rough, inaccessible country and the general design was to secure reliability and continuous operation.

Point of Intake

The plant is situated on Coffee creek, a tributary of the Trinity river, and about one mile from Carrville, taking water out of Coffee creek nearly two miles above the power house. Coffee creek rises in the extremely rough country where Scott mountains join the Salmon Alps. The flanks of the hills forming the watershed of Coffee creek are covered with a heavy growth of young timber, and since grazing has been perceptibly diminished under Forest Service administration, is rapidly becoming covered with an almost impenetrable undergrowth. Snow lays on the mountain tops almost the entire year, and this, combined with excellent cover on the slopes, insures a certain and rather even water supply.

This part of California has been, and still is a famous hydraulic mining section, several hydraulic mines still operating on Coffee creek, the tailings being discharged into the stream. For this reason it was not deemed advisable to build a permanent dam at the point of intake, as it would fill with detritus and become a menace. Instead a short concrete wing dam was thrown out from the bank at a point where solid rock was obtainable for foundations. A temporary dam of brush, cobble and bags is thrown across the stream in autumn when water begins to run low. When the spring freshets come, this dam and all impounded detritus is swept away, and the wing dam is relied on for diversion.

A rough screen, or rather grizzly, made from logs cut on the ground is placed over the intake to deflect heavy wash and protect the flume. The flume from intake to penstock is 9300 ft. long, 4 ft, wide and 34½ in. deep inside. For the first 1500 ft. after leaving the intake heavy work was encountered, the flume grade being blasted, and the ground having a natural slope of 45 degrees. Contour lines were followed closely and where a draw was crossed, a fill was made instead of trestle. Some trouble with slides was experienced when the first heavy snow was followed by a warm rain, but this had been anticipated. In no instance was a fill taken out and the only serious interruption during the past winter was when a tree fell across the flume, causing a shut down of six hours.

All timber for the flume, rough unplaned boards, was cut by the company, and the bents mortised in the company mill, but transported to the flume grade before framing. In building the flume, three gangs of men were worked. The first, under charge of an engineer, laid 2 in. x 8 in. stringers to grade; the second framed and placed the bents and nailed them to the stringers; the third gang laid the floor and nailed the sides. The accompanying view of the flume gives an idea of the timber growth on the watershed.

Flume During Construction

The flume is laid with a grade of 10.5 ft. per mile, and when running three-fourths full, carries 3100 cu. ft. per minute with a velocity of 5 ft. per second. This amount of water is more than sufficient for the present load, but it is the intention to increase the mill capacity, requiring more power.

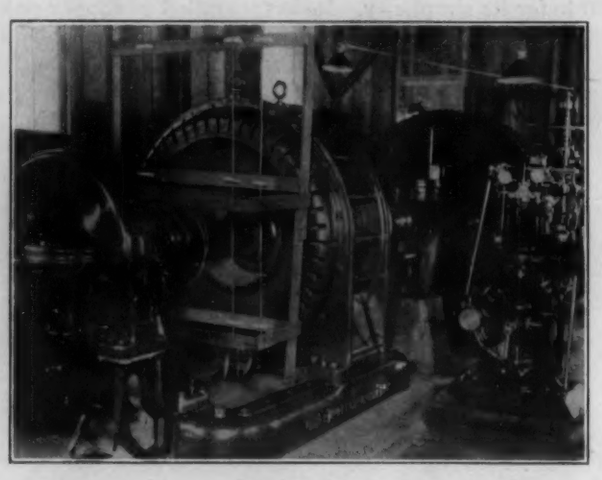
Both side and bottom opening gates are provided at various points along the flume, the type depending on the contour of the country. At the penstock the usual screens and waste flumes are installed. One turnout, as shown in the view, is installed about half way between the intake and penstock.

The pipe line is 500 ft. long, and leaves the penstock by a 6 ft. bell. It is 32 in. in diameter, No. 18 gauge steel for the first 250 ft. and narrows to 30 in., No. 14 gauge for the last half. Air valves are provided, but were frozen solid at the time of the writer's visit.

The static head at the wheel is 107 ft. Hendy hydraulic gates are installed between the pipe line and turbine. The pipe is laid in a trench the greater part of its length, and is anchored by earth tightly rammed. Due to the contour it was found expedient to ram the pipe from the bottom, instead of the top, as is the usual practice.

The wheel is a Francis turbine designed by O. C. Goeriz, built by the Joshua Henry Company, and runs 514 r.p.m. It is set on concrete foundations and the same foundations take the thrusts from the pipe line. The spiral casing is built from steel plates, riveted. This type of casing was adopted for ease of transportation and to insure ample strength for resisting strains from water hammer. Babbitted ring oiling bearings are used. The bearing projecting through the draft tube elbow is a ring oiling collar type bearing, to receive any unbalanced thrust from the runner. Discharge is made through 100 ft. of tailrace to Coffee creek, near its confluence with the Trinity river.

This turbine is fitted with the Voith type of control, a common method of regulation in Europe, but seldom encountered in American practice. In this type, the guide vanes are connected by links to a ring inside the casing. This ring, in turn, is actuated by two bell cranks, placed diametrically opposite, with their axes extending through the casing. To avoid obstructing the water passages, every guide vane has a pocket cast in it, completely embracing the link.



Generating Unit

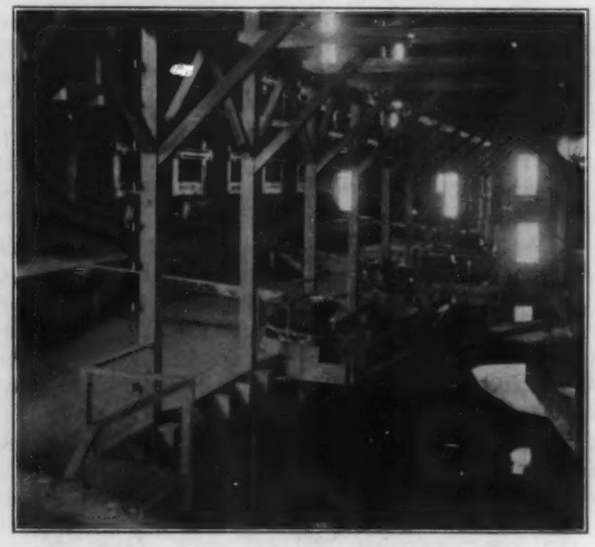
A Lombard type R governor is installed, and as this governor produces a rocking, or swinging, motion in its control member, it is connected directly to a shaft with cranks actuating those of the control ring. This obviates all lost motion by eliminating racks and gearing. Excellent speed regulation is obtained.

Direct connected by a flexible coupling, is a General Electric, 400 k.v.a. generator, wound for 4000 volts, three phase and 60 cycles. The pole line was designed for a 10 per cent drop, but as the original survey was not followed, a somewhat shorter route being taken, the generator is operated underexcited, generating at 3800 volts and connected straight to the line without transformers.

A two panel switchboard is installed, one panel for the generator, the other a line panel with the usual equipment. A Tirrel regulator is provided for voltage

regulation. Aluminum cell lightning arresters are placed inside the building, being connected to the line just inside the building wall.

The transmission line is 7600 ft. long, running over the floor of the Trinity Valley, and up the mountain side to the mine, crossing the river enroute. The line is No. 6 hard drawn copper, on brown porcelain insulators. One cross arm and the pole top are used forming a 48 in. triangle. The poles are 35 ft. long, cut on the ground, and cost 60 cents each, ready to set. Remarkable time was made in setting these poles, 63 in all, only 17 actual working hours being consumed, with a single pole gang of five men. No difficulty was experienced in digging the holes, an occasional boulder



Mill Interior

giving trouble in the valley, although not more than ten holes had to be shot. The river is crossed with a single span of 180 ft., single 50 ft. poles, double armed, being used.

At the mill a substation is installed. Three 125 k.w. 3600/440 volt General Electric transformers, connected in delta, reduce the voltage for mill and mine distribution. The incoming panel has an ammeter, voltmeter and automatic overload switch. Horn gap and aluminum cell lightning arresters are installed.

The distributing panel has six switches, controlling various light and power circuits. Two 5 kw. transformers, 440/110 volt are installed for lighting service. All wiring is carried in conduit, underground, between switchboard and transformers.

For operating drills in the mine, an Ingersoll compressor, belt driven by a 75 h.p. motor is installed.

At present mule trains are used to transport the ore from mine to crusher, a distance of 800 ft., but an electric locomotive will be installed in the near future.

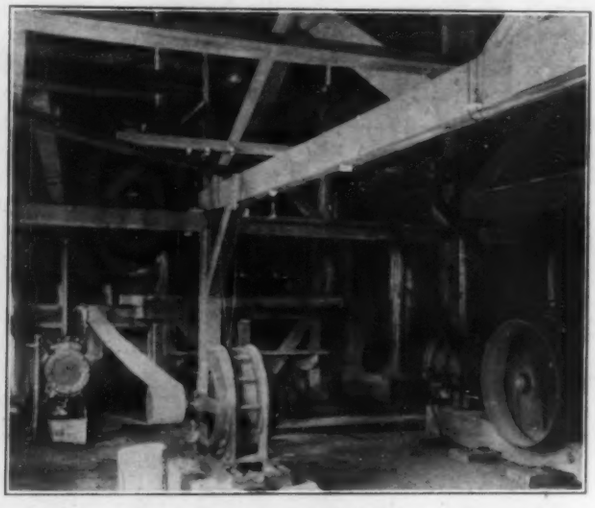
For crushing the ore before delivery to the bins, two crushers set in tandem, and belt driven by a 50 h.p. General Electric motor, are installed.

Two 16 in. belt conveyors, one running from the crusher house to the mill and discharging on the second running at right angles, and over the tops of the bins, carry the ore from crusher to mill. These conveyors are driven by 5 h.p. Ideal motors, geared direct to each head pulley.

The stamps, of which there are forty, weighing 1050 lbs. and dropping 102 times a minute, are driven in two groups, by two General Electric 50 h.p. motors, set under the ore bin. A special belt tightener is used on this drive, and it is the practice here to start the stamps without hanging up. This is not conducive to good voltage and speed regulation at the power plant, although the results are not as bad as one would expect in starting a 50 h.p. motor against a 100 h.p. load and only 320 kw. behind it.

As the cyanide process of recovery is used exclusively, the usual equipment of concentrating machinery is not found.

To supply compressed air for the agitators and general use about the mill a 10x12 in. Ingersol-Rand



Motor Drive in Mill.

enclosed type compressor, is belt driven by a General Electric 20 h.p. motor.

There are four pulp thickeners, installed in two groups of two each, and each group driven by a 5 h.p. Ideal motor.

Two Oliver filters are installed to separate the cyanide solution carrying the gold and silver from the pulp. These machines and auxiliary equipment form the most interesting group in the whole installation.

To maintain the proper vacuum on the filters for moving the solution, an Oliver vacuum pump is installed. This pump is a horizontal single piston pump, iron fitted throughout, and without valves in the suction ports. It maintains a vacuum of 25 in. on the filters, with 27½ in. barometer reading, and operates on the wet vacuum principle. It has a displacement of 192 cu. ft. per minute when running 90 r.p.m.

A 10 h.p. General Electric motor drives a countershaft to which is belted the two filters and vacuum pump.

To maintain the pulp in the filter tanks at a proper consistency, two centrifugal pumps, mounted on the same subbase with a 5 h.p. Ideal motor, have their suction pipes connected to the filter tanks near the pulp level. The discharge of these pumps is returned through the bottom of the tank, terminating in a set of revolving arms similar to a Barker mill.

For handling the pregnant solutions during precipitation and returning them to the various stock

tanks, three 5x6 in. Deane triplex pumps, geared direct to 5 h.p. motors mounted on brackets are installed.

A Gould 5x6 in. triplex pump belt driven by a 10 h.p. motor is installed for a reserve unit to the solution pumps.

A 2 h.p. General Electric motor is installed in the assay office for driving the usual crushing machinery found there.

Arc lamps are installed for lighting the cyanide departments, while incandescent lights are used for lighting the stamps and rock crushing plant. In the mill a catenary suspension is employed to swing the rows of incandescent lamps from end to end of the building. Arc lamps are scattered about the workings and mine buildings for night illumination. In addition to lighting the offices and employees' cottages, a branch line is run to Carrville for lighting hotel and stores.

As might be expected in a plant having an almost exclusive induction motor load, great difficulty is experienced with low power factor. It is seldom that a power factor as good as .80 is obtained. To correct this difficulty, it is probable that a synchronous motor-generator set will be installed when electric locomotives are substituted for mules on the mine tram.

The entire plant was built under the direct supervision of Mr. David Goodale, manager of the Trinity Gold Mining and Reduction Company.

E. L. Beck, who is now mill superintendent, had charge of the hydraulic development.

B. B. Brown is electrical engineer for the Company and had charge of all electrical work and the installation of turbine and regulating apparatus.

The writer desires to extend his thanks to the management for the courtesies extended in the preparation of this article.

In closing, a singular coincidence that occurred in starting this plant might be related. When the power was turned on, not a single connection had to be changed, every motor revolving in the right direction.

GOVERNOR WILSON ON CORPORATIONS.

In the course of an address at the University of California last week Governor Wilson of New Jersey said:

"We are no longer afraid of our corporations as we used to be, because we are beginning to understand just what they are, and, to some extent, at any rate, just how they can be controlled and made to serve the purposes of our life without governing and controlling us. There was a time when our feeling about them was almost one of panic. We had undoubtedly ourselves created them. There was no disputing the fact that they were our creatures, made by laws which we ourselves had enacted, and had supposed we understood; but we stood amazed at the work of our own hands, and not only amazed, but awed and frightened. It is not a little amusing, as we look back upon our one-time state of mind in this matter, because, having created the corporations, we can certainly alter them if we please, and control them in any way that we choose. They are not actual persons. We made them —God did not—and we can alter the work of our own hands as we will."

The speaker then proceeded to define corporations, and said they possessed no inherent rights such as are possessed by the individual, but only such privileges as a collection of individual, forming a community, had conferred upon them. The granting of these privileges, he contended, carried the right of control.

In referring to public-service corporations, Governor Wilson said:

"Public-service corporations, such as railroads, street railways, gas companies and companies which supply electric light and power, are in a still larger sense public instrumentalities. Besides having the artificial advantages and powers conferred upon the ordinary corporation doing what we call private business they are in partnership with the Government in the laying of rails, the erection of poles and wires and the laying of conduits as the means of transmitting their service. They have had delegated to them the Government's right of eminent domain, the right to make partial use of public highways, to condemn rights of way across pieces of private property.

"Moreover, they are in a very interesting sense natural monopolies. They generally use the pieces of land and the roads and highways which are most convenient to their purposes, and most direct for effecting the communication which they wish to effect; and it is perfectly obvious that if other companies are allowed to compete with them, there is a very wasteful duplication in outlay and equipment. So that competition generally results in an eventual combination of the competing companies and the necessity to charge a price on what they supply that will pay the interest on twice as great an investment as was really necessary for the service."

Governor Wilson then went on to discuss the difficulties that had beset the representatives of corporations and of the Government in trying to meet on a common ground to adjust the relations of the two. In this connection he said:

"The real difficulty in the management of our corporations in recent years has been the wrong point of view of those who were in control of them. They did not recognize that they were public trustees. They acted as if they were conducting their own private business. Let them change their point of view, and there is no problem to solve. There is no legislation necessary if they will but regard themselves as trustees of the common interest, bound by considerations not private, but public, in the conduct of their business."

In concluding the speaker said: "I think that the spirit of the age is slowly changing. The time of contest and vituperation and mutual abuse and misunderstanding is passing away. It is beginning to be recognized that those who are leading the reform movement of the age are leading it in all sincerity and genuine public spirit. Men of business are waking, to look about them upon the real facts and to make statesmen of themselves and public men are going half way to meet them in this new temper and purpose of theirs. We shall yet see a day of happy accommodation and of established justice."

TEST OF A HYDRAULIC RAM.[1]

BY G. J. DAVIS, JR. AND D. P. DALE,

The hydraulic ram was invented by John Whitehurst in 1772 and in 1796 Joseph Montgolfier improved it by making its action automatic. Since the latter date no important improvements have been made in its design.

Hydraulic rams have come into extensive use for pumping small amounts of water to isolated dwellings, hotels and other buildings situated near small falls, but it was not thought practicable to build and operate large rams until 1895, when Professor D. W. Mead designed and built a ram for supplying the city of West Dundee, Ill., with water. This ram had a drive pipe 10 in. in diameter and 2,200 ft. long and operated under a supply head of 43 ft. This demonstration of the practicability of large rams has led to their adoption in many places for pumping the water-supplies of small cities and irrigation projects.

On account of its entering into competition with other types of pumping machinery in moderate sized installations, it is becoming important to have more precise knowledge concerning the principles of design and of operation of the ram. During 1907 an investigation of the hydraulic ram was made in the Hydraulic Laboratory of the University of Wisconsin by L. F. Harza. In his investigation theoretical formulas accounting for the action of the ram were derived and checked by experiment, thus demonstrating the practicability by rationally designing hydraulic rams for any given working conditions.

In the usual installation a ram would not be specially designed for the conditions under which it is to operate, but one, or a battery of rams, of some commercial make would be selected. In order to make a wise selection it is necessary to know the characteristics of the various types of rams and the proper conditions for their operation. In determining these characteristics there are many practical problems which need to be solved experimentally. A few of them are listed below:

1. What is the effect of variations in the size of the air chamber?
2. What amount of water should be kept in the air chamber?
3. What is the best rate of closure for the waste valve?
4. What should be the range of movement of the waste valve?
5. What is the best type of waste valve?
6. What is the best type of check valve?
7. What is the proper proportion between the check valve area and the diameter of the drive pipe?
8. What diameter of drive pipe is best under various conditions of operation and installation?
9. What is the best length of drive pipe to use under given conditions as to supply and discharge heads?
10. What rate of stroke is best for given conditions of supply and discharge heads and length of drive pipe?

Theory of the Hydraulic Ram.

Any hydraulic ram consists essentially of three groups of parts as shown in Fig. 1: A supply tank, drive pipe and waste valve, a check valve and air chamber, and a discharge pipe and reservoir.

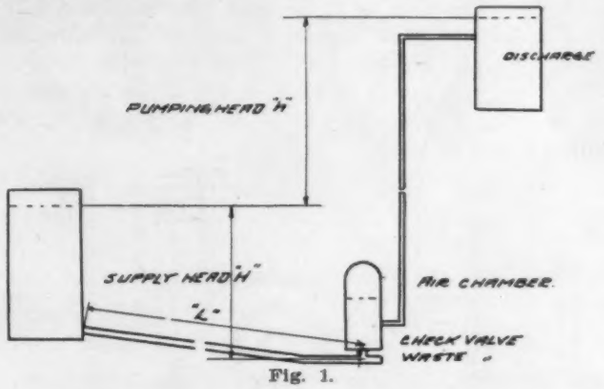


Fig. 1.

Nomenclature.—The following symbols will be used throughout this discussion:

H = head of supply tank on waste valve.
h = head of discharge reservoir on supply tank.
Q = rate of wasting water, pounds per minute.
q = rate of pumping water, pounds per minute.
r = rate of strokes, number per minute.
E = efficiency, per cent.

Manner of Working.—Let us assume the waste valve in Fig. 1 to be open. Due to gravity, water flows down the drive pipe with an accelerated velocity and makes its exit through the valve. This valve is so constructed that when the velocity of the water reaches a certain point, it will close suddenly. The result is a water hammer; the pressure in the pipe rises, forces open the check valve, and water enters the air chamber. It continues to enter until that pressure is relieved and equilibrium is established. Thereupon the check valve closes, the waste valve opens, and another cycle begins. Water has been forced into the air chamber against a high head; the air has a cushioning effect and produces a nearly uniform pressure in the discharge pipe. As the velocity of water into the air chamber is gradually extinguished, the pressure on the valve falls until it is equal to the pumping head. The water is now in a slightly compressed condition, and the walls of the pipe are distended. Such a condition is obviously unstable. The resulting contraction of the pipe and expansion of the water cause a flow back into the supply tank. The momentum of the resurge sets up a wave of rarefaction which reduces the pressure and opens the waste valve, thus starting another cycle. Were the waste valve to remain closed tightly, waves of compression and rarefaction would occur until friction damped out the accumulated energy.

Apparatus and Method.

The experiments were designed primarily for the purpose of ascertaining the effect of length of drive pipe on the efficiency and capacity of the ram.

The method outlined was to vary one factor while all the others are kept constant, and to vary in turn r, h, H, and L. It was believed that some of the runs could be omitted when the laws of variation were established. It was proposed to cover L at 20, 40 and 60 ft.; H at 4, 6, 8, and 10 ft.; and h and r throughout the range of which the machine was capable.

The apparatus consisted of a Columbia hydraulic

[1] The Wisconsin Engineer.

ram No. 195, cylindrical steel tanks for supply, discharge and waste, and a Crosby water gauge for registering h. The ram is 44 in. high and weighs 600 lb. The tanks are those regularly used in the hydraulic laboratory, and are fitted with calibrated glass gauges. The drive pipe is 62.4 ft. long, is 4½ in. inside diameter, and has a bellmouth fitted on the end to reduce entrance loss of head.

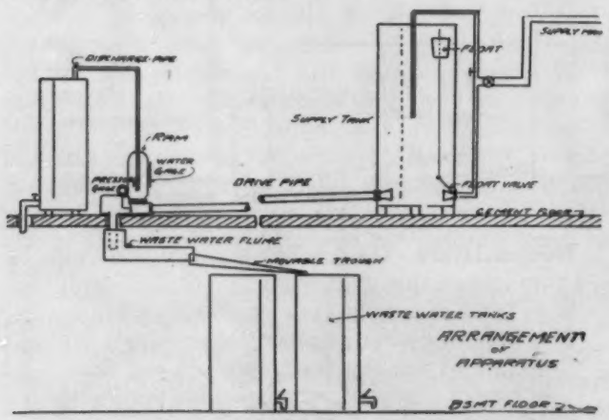


Fig. 2.

The supply head is fixed by the length of the wire joining the float in the supply tank to the arm of the float valve. Valves in the supply mains are set to give approximately the desired flow; the float valve takes care of minor fluctuations in supply and demand, and thus maintains a nearly constant H. In order not to introduce air into the drive pipe, and thus lose by air cushioning the water hammer effect, the ends of all pipes are placed well under water. The tension in a spring on the waste valve regulates r. A set screw device is used to fix this tension and thereby to govern r, the factor most often changed.

Two formulas for efficiency are in use:

Rankine, $E = qh \div QH$.

D'Aubisson, $E = q\,(H + h) \div (Q + q)\,H$.

Rankine's formula is used in these experiments.

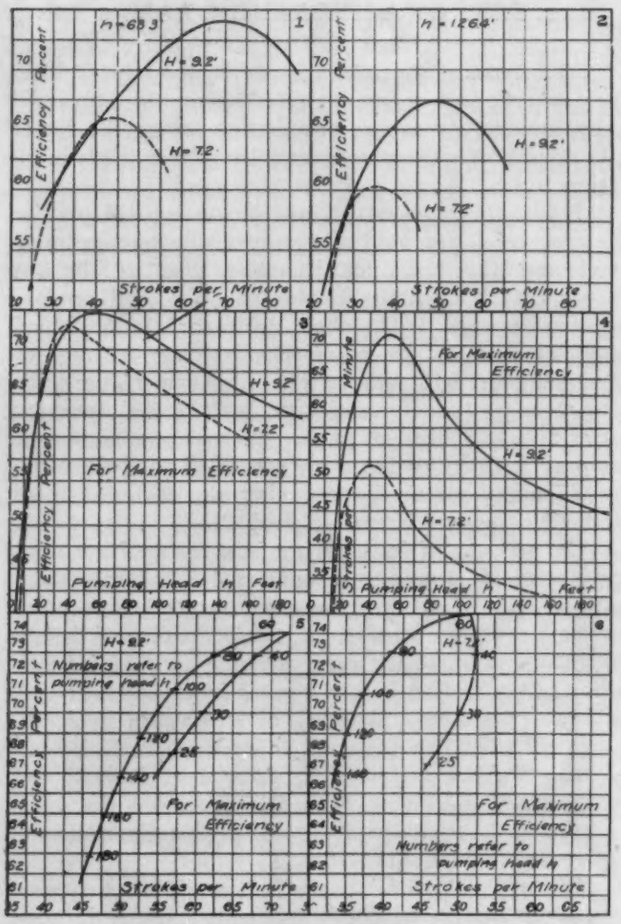
Discussion of Results.

The results of the experiments are shown in 140 curves, some typical ones of which are here given. The following outline shows the factors involved:

FACTORS INVOLVED IN CURVES.

Set of Curves	Variables	Constants	Remarks
1.....	E, r	L, H, h	h = 63′
2.....	E, r	L, H, h	h = 126′
3.....	E, h	L, H	For Maximum Efficiency.
4.....	r, h	L, H	" " "
5.....	E, r, h	L, H	H = 9.2′
6.....	E, r, h	L, H	H = 7.2′
7.....	r, q and r, Q	L, H, h	h = 63′
8.....	r, q and r, Q	L, H, h	h = 126′
9.....	Q, h	L, H, r	
10.....	q, h	L, H, r	
11.....	q, Q	L, H, r	H = 9.2′
12.....	q, Q	L, H, r	H = 7.2′

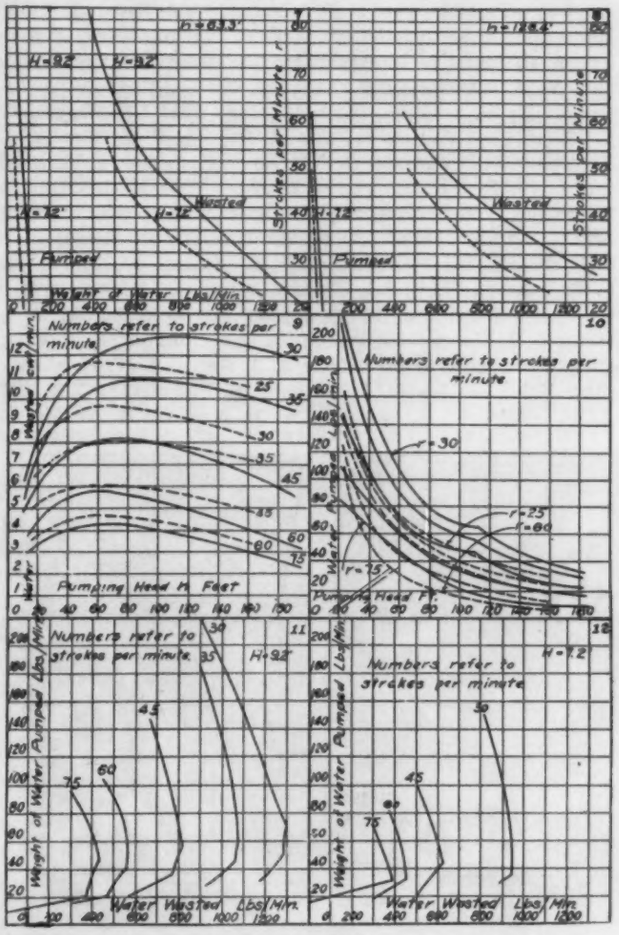
Set 1 shows the variation in efficiency with rate of strokes, H and h constant. E increases with r for a period and then falls off. Twelve such E—r curves were plotted with H = 9.2 ft., h varying from 24 to 186 ft. Of these, the full line curves of sets 1 and 2 are examples, viz., when h = 63.3 ft. and when h = 126.4 ft. The dashed curves are the corresponding ones for H = 7.2 ft. It may be observed that efficiencies are lower with the lower supply head. The curves for all pumping heads are similar and resemble parabolas.



Under the higher heads the range of rate of strokes is smaller, and the range of efficiencies is larger. This variation gives a more sharply defined maximum point to the curves for higher heads. It can be noted that the maximum point in the E — r curves as h changes from 24 ft. to 186 ft., rises for a time, and then gradually decreases. This rise and fall in maximum efficiency as h increases can be seen to better advantage in curve 3. It may also be noted that the maximum point moves simultaneously to the right, and then returns. This rise and fall in the rate of strokes for maximum efficiency can be seen in curve 4.

Curve 5 shows the simultaneous values of three variables: rate of strokes, pumping head, and maximum efficiency for that pumping head. It combines (3) and (4) by eliminating h. Suppose we have a fall of 9.2 ft., and wish to pump water to a height of 100 ft. Curve 5 shows that the maximum efficiency of 73 per cent will be secured by setting the machine to run at 63 strokes per minute. Curve 6 shows the relations existing under the condition H = 7.2 ft. When the series of experiments are finished, a number of curves similar to (5) may be plotted on one sheet, and will show for any combination of values of H and h within the range of the machine, the maximum efficiency that can be secured, and also what rate of strokes to use to secure the same.

The curves for Q (6, 7,) show that Q and r vary inversely. More water is wasted when the strokes are longer although there are fewer of them because the



Curve 7-12.

rapid increase in velocity acquired in the longer strokes more than offsets the effect of fewer strokes.

By curve 9 it may be seen that with r constant, as h increases, Q increases up to a certain point, and then decreases. By curve 10 it appears that q decreases always as h increases.

This constant decrease of q, and rise and fall of Q, as h increases, is shown in curves 11 and 12 for the different values of r.

Later experiments by A. E. May and H. N. Brue show the following results, when L = 42 ft. as compared to those obtained when L = 62 ft.:

The range of r^1 (where r^1 = rate of strokes for maximum efficiency as in set 4) is about twice as great. The range of efficiencies is also nearly twice as great. In order therefore to get good efficiencies with the short drive pipe, more care must be used in the adjustment of r for h. Efficiencies generally are lower with the short pipe; the curves cross.

Q is considerably greater, and q is slightly greater. This result agrees with the attendant circumstance that efficiencies are lower.

General Conclusion. When high efficiency is desired, operate according to curves 5 and 6. Maximum efficiency is usually secured by running at a fairly high rate of strokes. When maximum capacity is wanted, and efficiency is of secondary importance, run at the lowest possible rate of strokes.

ECONOMY OF THE TUNGSTEN FILAMENT LAMP FOR SMALL CONSUMERS.

It is surprising, and yet somewhat to be expected, that the average householder should be slow in adopting the tungsten lamp for general use in his home. There are a number of reasons for this, chief among which are the lack of knowledge of the effectiveness and economy of tungsten filament lamps, and their comparatively large first cost.

The present tungsten filament lamp is more fragile than the carbon lamp and will not stand rough treatment given it through ignorance or carelessness. Now and then there are complaints that tungsten filament lamps have stood up only a comparatively short time and nothing other than the first cost is considered when the complaint is made.

Below is given a brief table showing the short time it is necessary to burn the lamp in order that the saving in current consumption may equal the difference in cost price between a 25-watt "Mazda" and 60-watt carbon and between a 40-watt "Mazda" and a 100-watt carbon lamp. These are the sizes of lamps most generally used in residence lighting and the table will make it apparent that each additional hour of burning after the difference in price is made up means a big interest earned on the investment. In fact, the lamp will actually pay for itself several times over besides giving a quality and quantity of light that is most satisfactory. One 25-watt "Mazda" has about the same candlepower as one 60-watt carbon. One 40-watt "Mazda" is about equal to one 100-watt carbon. The 25-watt "Mazda" costs 65 cents, the 40-watt "Mazda" 70 cents, the 60-watt carbon 20 cents and the 100-watt carbon 30 cents.

There is given below the number of hours necessary to burn a "Mazda" lamp to save in current enough to equal the difference in price between it and an equivalent carbon at various current costs.

	Hrs.		Hrs.
6c per kw. hour.			
25 w. "Mazda"	220	40 w. "Mazda"	110
60 w. Carbon	100	w. Carbon	
8c per kw. hour.			
25 w. "Mazda"	160	40 w. "Mazda"	85
60 w. Carbon	100	w. Carbon	
10c per kw. hour.			
25 w. "Mazda"	130	40 w. "Mazda"	65
60 w. Carbon	100	w. Carbon	
12c per kw. hour.			
25 w. "Mazda"	110	40 w. "Mazda"	55
60 w. Carbon	100	w. Carbon	
15c per kw. hour.			
25 w. "Mazda"	90	40 w. "Mazda"	45
60 w. Carbon	100	w. Carbon	

The above take in the usual ranges of prices of current and sizes of lamps in residence.

It might be well to add that pendant or wall switches should be used where tungsten filament lamps are installed and that they should not be taken out of the socket and dumped into a dishpan to be washed. Lamps should be cleaned with a moist cloth while burning. This precaution, if observed, will do away with considerable breakage and resulting dissatisfaction.

The advantages of tungsten filament lamps for residence lighting are obvious. Interior finish is almost uniformly dark in color in the more used portions of the modern home and plenty of light is absolutely necessary as side wall reflection is almost totally lacking. The "Mazda" lamp affords the most economical means of gaining this desired end.

ENGINEERS DINE IN POWER PLANT.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers was held in the Southern Pacific Company's new electric power plant at Fruitvale on the evening of May 19, 1911. The design and construction of the plant were described by A. H. Babcock and his assistants and the visitors were given every opportunity for complete inspection. These papers will be published in an early issue of this journal. A subsequent meeting at the Oakland shops will be devoted to the line construction and car equipment of the Alameda County electrification for which this plant furnishes the power.

This meeting was preceded by a banquet at which a hundred or more engineers enjoyed the hospitality of the Southern Pacific Company. The dinner was unique, in being served on the main floor between the two 5000-kw. steam turbo-generators and the rotary converters, a score of waiters from the Southern Pacific diners attending to the wants of the party.

Photo by H. C. Tibbitts Dinner Given by Southern Pacific Company in Fruitvale Power House.

The guests included those members of the local section who have been most regular in attendance, the heads of departments of the electrical engineer's office of the Southern Pacific Company and representatives of the companies which furnished all the plant equipment. The list follows:

B. C. Edgar, J. J. Ferrier, F. E. Manzer, W. C. Myers, R. Page, Wm. Redford, F. H. Searight, G. W. Welsh, R. M. Alvord, C. F. Adams, A. H. Babcock, F. G. Baum, E. F. Bivins, A. J. Bowie, Geo. H. Bragg, Henry Bosch, Ralph Bennett, F. F. Barbour, H. W. Clapp, S. K. Colby, C. L. Cory, H. W. Crozier, J. G. De Remer, P .M. Downing, K. G. Dunn, R. B. Daggett, E. I. Dyer, W. H. Evans, S. L. Foster, R. H. Fenkhausen, Herbert Gaytes, H. Y. Hall, W. W. Hanscom, John C. Hays, Dorsey Ash, A. H. Halloran, L. F. Halloran, W. A. Hillebrand, G. C. Holberton, A. M. Hunt, C. S. Hull, C. W. Hutton, G. S. Johnson, A. G. Jones, L. R. Jorgensen, J. P. Jollyman, Geo. I. Kinney, W. F. Lamme, H. A. Lardner, O. W. Lillard, S. J. Lisberger, R. W. Lohman, H. A. Laidlaw, Paul Lebenbaum, W. C. Miller, Fred F. Mumma, Geo. R. Murphy, F. S. Hurst, S. L. Napthaly, W. F. Nieman, C. F. Orra, H. C. Parker, H. R. Roeding, L. St. D. Roylance, H. A. Russell, A. G. Ramstad, G. A. Schneider, Wm. H. Shepard, E. O. Shreve, H. H. Sinclair, F. E. Smith, Sidney Sprouut, A. B. Saurman, H. E. Shedd, C. E. Sedgwick, R. W. Van Norden, F. E. Vickers, W. G. Vincent, F. T. Vanatta, M. Vestal, Chas. J. Wilson, J. E. Woodbridge, C. T. Hutchinson, A. R. Thompson, A. D. Schindler, G. L. King, F. B. Clapp, D. J. Patterson, C. S. Stanton, R. F. Chevalier, Thos. Mirk, W. W. Slater A. A. Serva, S. W. Estabrook, Chas. Baker, R. Adams, J. Johansen, H. F. Jackson, C. R. Gill, J. W. White, W. R. Scott, F. W. Hoover, W. H. Norton, H. Stillman, W. A. Cattell, G. W. Dickie, G. L. Henes, J. N. Le Conte, E. A. Rix, J. C. H. Stut, G. R. Babcock, J. B. Struble, M. E. McKay.

Examination for Second-Class Steam Engineer is announced by the United States Civil Service Commission on June 21, 1911, to fill vacancies as they may occur in the position of second-class (or assistant) steam engineer in the departmental service at Washington, D. C. The examination will consist of letter writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first class public buildings), training and experience in mechanical and electrical engineering, and fitness.

SECURITIES OF WATER POWER COMPANIES AS INVESTMENTS.[1]

BY H. M. BYLLESBY.

Until recently it has been nearly the unvarying rule of men busily engaged in industrial or commercial pursuits to avoid everything resembling or pertaining to the making of addresses such as you have honored me with in your invitation to speak here.

However, within a comparatively brief period it has become necessary for those of us who are actively engaged in such pursuits to make a beginning by availing ourselves of the opportunities of addressing bodies of intelligent men for the purpose of placing before them certain real facts correctly stated in order to do away with, as far as possible, the present attitude of many of the magazines and politicians and those who pander to discontent by their misstatements regarding the work and methods pursued by those industrious men who are, while endeavoring to make something more than a mere livelihood for themselves, building up the country by developing the otherwise undeveloped and raw natural materials for a useful purpose and at the same time affording a means of livelihood and profit to a large number of others and as we hope and believe, helping forward the progress of civilization and ameliorating in general the conditions of human life.

Therefore I will ask you to regard my remarks as being those of a man who is unaccustomed to public speaking, but who believes what he says, and if what I have to say to you will be accepted in that spirit and, further, shall be of the slightest benefit to you young men before me who are about entering on the serious work and problems of life, and if at the same time in any sense it serves to give you a different view of modern commercial enterprises from that set forth in irresponsible magazines and on the part of discontented demagogues who, as always, are appealing to the unrest in the community, I shall feel amply repaid.

Growing Demand for Electricity.

Month by month and year by year the uses of electricity are increasing. In the earlier days it was necessary to demonstrate to the prospective user of any electrical device that it would actually perform its function; that the cost of the device or the cost of the electricity to operate it would not be prohibitive, or that some other device operated by some other force would not shortly take its place. Today all this is altered and from one end of the country to the other the usefulness and facility of the electric motor is recognized, the usefulness and advantages of electric light are recognized, the uses of electricity for many chemical processes are well known, and the question with any given prospective user in any given case is merely one of the cost of the electricity as compared with whatever other force or prime mover or illuminant may at the moment be at the disposal of such a prospective customer.

And this wonderful development of the use of electricity for industries and for comfort and for the luxuries of life is such today that any new use for electricity, even in our domestic establishments, the use of electricity for operating cleaning devices, flatirons, subsidiary cooking devices, is recognized, and again with the householder it is only a question of his ability to pay the cost of the device in the first instance, and the continuing cost of the electricity to operate.

Now there is hardly any business or enterprise which has ever been introduced which has such a unique demand for its product as do the manufacturers of that thing we call electricity.

Another feature leading to the stability of the bonds and stock of hydroelectric companies as investments is, speaking broadly and generally, there is a comparatively limited number of available water powers, either developed or undeveloped, and while in certain sections of the country there is a great overplus of water power, yet generally throughout the country there is far less water power than is equivalent to the total requirements for electricity for power, light and the subsidiary uses in the sections in which these water powers are located, and with rare exceptions, in fact the exceptions being so few in number as to be negligible, even in the sections which have been endowed by nature with an overplus of water power, those that have been developed, while temporarily oversupplying the market, have rapidly found uses for all of their product.

Finally and as a general rule, the class of men who heretofore have been connected with the development of hydroelectric projects have been men of character, of integrity, and generally their projects have not been seriously overcapitalized, almost without exception the enterprises have been honestly administered and there has been a certain enterprise and enthusiasm on the part of the men engaged in the development of these enterprises which has been of a high order and which has led to great enthusiasm and conscientious devotion to the interests committed to their charge.

So far there has been comparatively little of what is called "stock jobbing" connected with these enterprises; there has been comparatively little of the purposely embarrassing of these corporations for purposes of ultimate selfish greed and broadly it may be stated that there is no class of investment which has been more honestly administered, more industriously operated, or where the management has a greater degree of integrity than in the class of investments covered in the subject upon which you have asked me to speak.

Beyond this it is inevitable that in the near future the present 5 per cent (and in some cases 6 per cent) mortgage securities of hydroelectric properties will be refunded into 4 per cent mortgage securities and that the preferred stocks of these companies will sell on a 5 per cent basis, and the natural consequence of this will be to the present holder of the bonds and stocks of the hydroelectric companies, that he will find his securities called in under such terms and conditions as are provided in the instruments covering the issuance of those securities, for the purpose of being refunded into lower interest bearing stocks or bonds.

Now I shall touch later on upon certain disappointing cases which have arisen in the hydroelectric business and I shall be able to give you the specific reasons for those disappointments and I shall be able to point

[1]Extract from address at University of Pennsylvania, April 7, 1911.

out how, notwithstanding the disappointments in practically every case, the enterprises eventually came out so that the original investors did not lose any of their principal and even in many of the disappointing cases not only regained their principal, but a more or less handsome speculative profit in addition.

Management.

The duties of the managers of an hydroelectric property are continuous and unremitting; there is the public to be dealt with, which is always a question requiring tact and thoughtfulness, and the public can only be dealt with successfully where the manager of a corporation is imbued with and firmly believes in the underlying principles of Anglo-Saxon justice and fair play. A management which deals in smart tricks, which cuts sharp corners, which in any sense fools the public, which says "the public be damned," you can depend upon it, will sooner or later bring the property under its charge into greater or less disrepute and financial loss.

A man to make a success in this or any other department of modern business must stand squarely upon the platform of dealing honestly with the public, with his associates, and with the interests committed to his care. This is tact, and the smartest thing that any man can do is to be absolutely and continuously honest, and such embarrassments as some of the public service corporations have had you can in almost every case trace back to trickery, to an attempt to fool the public or the shareholder. Fortunately that situation is passing away forever.

In addition to this the management of an hydroelectric proposition must be alert and active, must be continually looking for further profitable sales of its product, must be continually on the alert to fortify its position as regards possible competition, the loss of business or the invasion of its rights, the management must have financial ability so that from the means at their disposal they will seasonably and in advance of the actual requirements provide funds for the continuing extensions and developments and enlargements which is the almost universal experience of hydroelectric developments. The management, for instance, must not overstay the market and eventually be forced to raise its funds in a bad money market under humiliating conditions or perhaps at ruinous interest or brokerage rates.

The management, while providing for the foregoing, must at the same time do all those common sense things which result in giving a corporation, the same as an individual, a good credit as distinguished from a bad credit. No individual can tell at what moment he may be called upon to use his own credit or the corporation be called upon to use its own credit to tide over fortuitous or temporarily disastrous conditions, and the concern which is in high credit will always be able to do this, where the company which has not paid attention to this question of credit may be very seriously embarrassed.

Further than this the management must be on the alert for new and useful methods for the consumption of electricity which can be continually, from time to time, brought before the consumers of such company; only in this way can the company go forward and fulfill the maximum earning capacity and satisfaction to the public which it serves.

Capitalization.

Another point in dealing with prospective investments in hydroelectric propositions is the design of the capitalization of such corporation.

Among the disappointments incurred in this business in the past from causes which I shall explain in detail subsequently one of the most frequent has been the inflexible nature of its devices for raising capital. Any and every hydroelectric enterprise in addition to being provided with ample cash working capital, so that it may discount its running accounts and always be in funds for prompt payment of its mortgaged and capital interest and dividend requirements, should further be so equipped by the arrangement of its capitalization that at any time by the sale of bonds or additional capital stocks it can provide funds for further development of its business.

Conclusions.

Generally, in summing up the foregoing, I am of the opinion that as a class, hydroelectric securities are exceeded by no other class of securities both in their stability and in the return which they properly are enabled to make upon their investment; the field of their operation is continually expanding due to the continuing growth of the use of electricity for almost every conceivable purpose, and in selecting a given investment naturally one would consider the present financial condition of the company, its management, its means for raising further funds, the physical condition of its property, as well as its earning capacity in view of the necessity or lack of necessity of steam reserve or the fluctuations of the stream which operates it.

Heretofore I have given you as briefly as the subject would allow, a general resume of the main points which, as I understand, are covered in the question on which I have been asked to address you. I wish, however, now to warn you of the things to be avoided and in this connection I would not for one moment disguise from you the fact that a certain proportion of these enterprises heretofore undertaken in the United States and Canada have proven temporarily disappointing and for a time many of them have appeared as disastrous failures, due, however, to reasons which are well understood and to causes which no one will have any excuse for neglecting in the future. The primal causes of disappointments, of temporary disasters, and in one or two cases failures (and there are not more than one or two to my certain knowledge) that have occurred, in the entire range of the subject, can be reduced to:

First: Underestimating the cost of the project.

Second: To mistakes made in the measurement of the flow of the stream to be developed.

Third: Inflexibility of the financial design.

Fourth: Absence of surplus.

Underestimating.

As to the first, I consider it one of the crying evils of the entire engineering profession, including the architects of today, which is an almost invariable and unfailing underestimating of the cost of any given project, and in hydroelectrics it has been more excessive and more heartbreaking than probably in any

other industry because there have been more uncertainties connected with the estimating of the cost of such projects.

The so-called "McCall's Ferry" project, with which all of you are more or less familiar, and you certainly are if you are connected with any large banking interests, went into temporary disaster requiring drastic reorganization, due to the fact that not more than 50 to 60 per cent of the cost of building this enterprise was provided for. And this disaster was further aggravated by no provision in the capitalization of the company to allow for the raising of additional funds when the original moneys provided had been exhausted.

As an example of the proneness of technical men to underestimate the cost of construction and to which they are as prone as the sparks to fly upward, and from which many technical men never shake themselves loose, I will mention the instance of a body of experienced and able men in the hydroelectric business, their experience extending over a period of well nigh fifteen years, where in developing a large and very necessary reservoir they made some soundings (but not enough), they dug some test pits (but not enough) and located what they believed to be a rock ledge upon which they have begun to build a dam to empound the water in the reservoir, and now, after having closed the door for the raising of further funds, they find themselves in an extremely embarrassing position, because contrary to all geological data at their command, contrary to the showing of their test pits, this ledge of rock, instead of drifting uniformly across the gorge where the dam is being built, has now developed a "fault" at the center of unknown depth, and which can only be bridged over or made safe by the expenditure of about 25 per cent of the cost of the project, and if it were not for the fact that the men back of this enterprise had large individual personal means and ample credit, the raising of this additional money with their closed issues of bonds and stock would probably force this particular enterprise to a drastic reorganization.

Therefore, I urge upon all of you who are expecting to be connected in any way with the enterprises of which we are speaking, to make your estimates with the most painstaking care and conscientious toil, to leave undone no amount of work or experiment which will serve to make certain the grounds upon which you are making your estimates and beyond all this and after having estimated liberally for all requirements so far as you can see them, to provide additionally a substantial sum of money and at the same time to so set up your financial arrangement that if contrary to your expectations your original estimates are overrun, and the extra amount of money provided is exhausted, and you still have capital requirements in order to finish your enterprise, you may have the means to do so without forcing the property to a miserable reorganization.

Legalities.

And in addition to the necessity of estimating and providing for as carefully as you can the many requirements for the physical part of the development, do not forget to see that the legal end of every feature of your proposition is attended to beyond peradventure. Many hydroelectric enterprises have been put to very great expense and great hazards, due to faults in the legalities of their real estate, their flowage rights, their rights of way, or the privileges of occupying public highways, and in many cases due to faults in these so-called "legalities" at the critical moment they have been held up and forced to pay a monstrous figure for a small bit of overflowed land, for an unprotected portion of their right of way, or due to some flaw in real estate titles, and it has frequently occurred that these so-called "hold ups" have happened at a time when the enterprise could not possibly wait to fight the question through the courts as the attendant loss of credit with the underwriters and the public, and the attendant loss of income, possibly resulting in the washing away of partly finished construction, made it imperatively and absolutely necessary to pay the "blood money" price required and all of which would have been avoided if the legal details had been properly and carefully attended to at the beginning.

Load Factor.

I wish to touch upon the question of what is technically termed "load factor." It is easy to deceive one's self by a high rate received for the sale of electricity, and to make an investor either in securities of a going hydroelectric company or one who is contemplating joining a preliminary underwriting, to be woefully deceived by the statement that in a given case the company will receive $75 or $80 or $100 or $150 per h.p. Now suppose that in a given community or given industry, due to its high rate of cost of fuel, you did receive a rate of $150 per h.p. but that your load factor was, for instance, 20 per cent. Your gross income from a given plant would be no better than if you had a load factor of 100 per cent and sold your electricity at $30 per h.p., and I have known of extremely disappointing cases resulting from promoters and managers being carried away by the large unit price for electricity where owing to conditions of its use a total gross revenue of but small amount was received, and this runs naturally into the very broad question of the sale of secondary electric power, by which is meant the sale of electricity at irregular intervals and in irregular amounts.

You may have a given hydroelectric development, for instance, which for six months in the year can deliver to the consumers continuously 10,000 h.p. and for the remaining six months can deliver only 5000 h.p. or the fluctuations and extremes may be more wide than I have stated. Now, owing to the comparative newness of this business, and the enormous number of things which people connected with it have had to give earnest attention to, the question of the sale of secondary power has as yet not reached the proportions to which it is entitled and broadly has been disappointing. I confidently believe, however, that the time will come when the hydroelectric development in any normal situation as to market will be able to sell to some one every kilowatt of electricity which it is able to turn out from the water flowing through its works. One very practical way to accomplish this, particularly in your eastern section where the bulk of your industrial enterprises operate on the so-called eight or ten-hour day, is to arrange, as can be done, that certain of

the users of this electricity work at night instead of day time, if only for part of the year.

Income From Secondary Power.

If, in a given eastern location you had a 10,000 h.p. hydroelectric proposition, and you had consumption of power for the operation of trolley roads, some small electric lighting and largely for furnishing power to industrial enterprises, happened to be 10,000 h.p., but that from 6 o'clock in the evening until 7 o'clock the following morning you had only a small load for part of that time from the trolley system, a heavy peak load for the balance of the period, you would immeasurably increase the earnings of your property without probably any material increase in the operating expenses if you could induce certain of your consumers or certain manufacturers who are not taking power from you in the day time, when you did not have it, to operate at night during which period they would purchase power from you.

Also with further study and development it will be found feasible to furnish to given manufacturing enterprises excess electricity, they using their steam plant to carry all or a small part of their load as the case may be, purchasing from the hydroelectric company necessarily at a low rate owing to the lack of guarantee of service, such electricity as the hydroelectric company can furnish from time to time.

Cost.

As to the cost of hydroelectric developments, it is no more possible to give any really guiding figures than it would be to state the size of a piece of cheese. The cost of these developments varies through the widest possible limits, and the market justifies or fails to justify to very wide limits, the varying degrees of cost of these propositions. And in this regard there is one very great danger, one very serious pitfall I wish to warn you against, which I am glad to say is becoming appreciated by engineers, managers and the public at a rapid rate, and that is that the cost of your transmission lines, your substations, your extensive subsidiary apparatus, your pole line right of way, and your individual distribution will in many cases exceed the cost of the hydroelectric plant, and very rarely is materially if any less than the cost of the plant, because if the same painstaking care and thorough workmanship is lacking in the transmission lines or extensive subsidiary apparatus of a plant which has been given properly to the building of the dam, power house and general machinery you will have continuous, difficult and expensive repairs, interrupted service, and a generally unsatisfactory condition of affairs.

In our experience, which has been fairly broad, we have known the cost of completed water powers of large dimensions, including their transmission lines and substations and a small amount of local distributing line for large power consumers, to run as low as $125 per installed h.p. We have also known them at the same time being commercial successes, to reach $700 or $800 per h.p. A steam plant, not including any distribution system, but simply the power house, boilers, engines, generators and internal subsidiary apparatus broadly vary from in very large plants $50 or $60 per h.p. to $125 to $150 per h.p., but all of these general figures I think are repugnant to any correct general view of the situation. Each case must be carefully examined from the conditions bearing directly upon it, and deductions made in accordance with a careful study with the experience of the investor himself or guided by the experience of some other man of experience upon whom he can depend.

With the daily increasing demand for electricity for almost every conceivable purpose from electric light, through power, chemical processes, power for pumping, for its use in the household, in the office and in almost every detail of human life, and with the further development of the sale of secondary electricity, and even with a fair reduction in some cases in the price now charged, the prosperity of all properly built and properly financed hydroelectric propositions should continually incease.

Conservation.

In the West we have our own quarrels with the Conservation Policy of the Federal Government and of the various State governments, and as this while at the present time more or less local, is becoming anything but local in its bearing on the collateral interests involved throughout the United States because a suspension in the further development of water power projects has its direct reflex effect not only upon the communities depending upon such developments but also upon the entire fabric of the manufacturing interests of the country, the copper producers and manufacturers, the manufacturers of electrical and water wheel machinery, the manufacturers of structural iron and steel, the manufacturers of cement and building materials, and the railroad companies suffering or prospering in accordance with the absence of transporting of materials for water power development or transporting such materials, and therefore on this subject I wish to say a few words.

Up to three or four years ago, and in many cases at the present time, the men of enterprise and who were able to provide capital to develop hydroelectric enterprises in the western states have been welcomed by the entire community. It has been recognized that where a given stream for countless ages has been flowing through an untenanted wilderness, serving as far as the power of the stream is concerned, no useful purpose, there has been a desire to provide the proposed company with a free gift of the power proposed to be developed, free right of way, not to hamper them as to rates, recognizing the difficulty of providing capital to build such enterprises, recognizing the brain and genius required to think out and plan the enterprises and recognizing beyond all this, the very great appreciation in value resulting to all the tributary population, property and interests in the communities to be served by such hydroelectric development.

I have been working in this field for many years, being one of the earliest workers and it has been only recently that it has been at all a simple matter to provide capital to develop some of the propositions which have proven most highly profitable. There was skepticism on the part of the investor, and skepticism on the part of the banking interests. There was the antecedent history of so many enterprises which had been embarrassed if not reduced to tem-

porary failure by costing more than had been expected, and heartbreaking anxieties on the part of the investor, the promoter and the builder. In addition, the long history which by a fatality seems to have attended nearly every hydroelectric development which is, no matter how carefully in the past the maximum and minimum flow of the stream has been ascertained from such records as were available, that nevertheless during the progress of the construction work a given stream has violated every previous record, either as to high or low water, entailing temporary disappointment or monetary loss.

All these conditions have been recognized generally in the past, but a few years since the cry went up that while in the east a very material part of its great commercial development had resulted from the free development of the natural resources, water powers included, without any exasperating or drastic restrictions. That, notwithstanding this, the wilderness of our western country, which is sparsely settled, where the power is generally grievously needed by the commercial interests and the inhabitants, that in these cases the mortmain of Federal and State Governments must be placed upon such enterprises; that they must be hampered and impaired in every conceivable way until finally by the straining of every possible interpretation of the laws and by the creation of new laws, the Federal Government, and many State governments will allow the development of non-developed water courses under conditions which are almost prohibitive. The conditions broadly and generally being that they will give a permit to the hydroelectric company to put up its works, costing several hundred thousand or many million dollars; they will allow them to occupy the stream for a limited period of twenty or forty years; they sometimes reserve the right to regulate the rates which the coporation may make, and reserve to themselves the right, in some cases at any time during the period of the permit, but in all cases under the present program, at the termination of the permit, to do anything they see fit with the hydroelectric development. The government can refuse to renew the permit; it can force the company to remove its works or renew the permit at ruinous rates, all to be determined by the wisdom of the Federal or State officers at the time that this contingency arises.

Along with these permits a royalty charge is made for the use of the water, which no company seriously objects to. What is objected to is the "making of bricks without straw"; offering these permits under conditions which make it impossible to raise capital to build them.

As to the general conservation policy of Federal and State Governments, there are of course, as in every question, points of merit which every fair minded man thoroughly agrees to. In the timber policy, there is no reason whatever why if a tract of timber is cut over, new trees should not be planted, and the man who cuts the timber should be forced to plant new trees or follow any other wise provision.

In yielding water power privileges to companies on public domain, no company will object to the payment of a fair and proper royalty on the water used, but to follow a policy as outlined by men who as a rule have accomplished nothing in the world excepting as to politics, who could not either devise such a project, as they are now legislating against, or if they could devise such a project, would know of no nook or cranny in the wide world where they could command sufficient credit to raise a dollar towards it, and to have men of this sort actuated by more or less fanatical motives, appealing as most of them do, to the ignorance and prejudices of the public, enforcing policies which put the dead hand of the law upon one of the most notable achievements of the Anglo-Saxon race in the United States, which is its enterprise, brings up for immediate and serious thought on the part of all fair-minded people, such a modification in the spirit of these policies as will conserve that most valuable asset which the people of these United States have heretofore possessed, but which I fear they are beginning to lose very rapidly, and which is the industry, enterprise and the daring courage of the energetic men who have developed the resources of this country, and which these unfair policies and unfair laws will inevitably drive to fields of industry in Canada or South America or elsewhere.

ELECTRICITY IN BRITISH SOUTH AFRICA.

Some interesting facts relative to the progress of electricity on the Witwatersrand are shown in the annual report of the Government mining engineer.

There was a large increase in the use of electrically driven machinery in connection with the mines, the horsepower of motors having risen during the year ended June 30, 1910, from 76,299 to 108,354. Owing to the fact that the electrification of the power supply of a majority of the mines is now rapidly going ahead, this total will be largely increased during the present year. This scheme contemplates not only the employment of motor-driven turbo-compressors for supplying compressed air, but motors will also be used for winding and pumping and in a majority of cases for the mill drive. The induction motor has been chosen by many of the mines for winding purposes, this being generally the case when it was necessary to convert an existing steam hoist, but it is understood the Ward Leonard system has been adopted in most instances where a completely new winding plant was required.

Examination for First-Class Steam Engineer is announced by the United States Civil Service Commission on June 21, 1911, to fill vacancies as they may occur in the position of first-class steam engineer in the departmental service at Washington, D. C. The usual entrance salary of this position is $1200 per annum. The examination will consist of letter writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first-class public buildings), training and experience in mechanical and electrical engineering, and fitness. While graduation from a technical school is not necessary, it will be given due consideration in the rating of the subject of training, experience and fitness.

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POWER AND GAS

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Electricity in Mining

Mining, like growing potatoes, is a commercial possibility only when the economic laws governing cost of production and market value can be satisfactorily adjusted. The fact that a mine may contain the necessary mineral deposits is but one of the features which control this adjustment.

When the mines on the Comstock Lode of Nevada were at the height of their production, all power machinery was driven by steam, which in turn was generated from fuel of high cost, for coal was brought great distances, while wood soon depleted the forests. During this period the ore was of sufficient richness and the mines easily enough worked to make the production commercially of great value, notwithstanding high unit costs. As the mines became deeper, and the best ore was worked out, there came a time when the costs of operation overbalanced the output and business practically came to a standstill. There still remained large quantities of gold and silver to be mined, but the economic conditions surrounding the mining were such as to make ground, once of untold value, practically worthless.

The advent of cheap electricity and modern electrical machinery instantly changed the economic conditions; pumps which to that time could be worked only at the greatest cost or not at all, could now be cheaply and easily operated, restoring drifts which had been considered lost to the world. A new lease of life was given by making one kind of Nature's resources assist in working another.

For modern mining it is necessary to have power and water, and where these necessities can be had easily and cheaply, the business of mining stands the best possible chance of continued success. It is for this reason that many low grade mines, situated in mountainous places, operate year in and year out as steadily as a shoe factory and make a consistent profit at every cleanup, while desert mines, rich in deposits, but lacking the advantage of cheap power and water, struggle fitfully and often fail.

Many of the older mines on the "Mother Lode" of California which have been good payers, have had these cardinal advantages by being so situated that water under high pressure could be brought directly to the mines to supply the power needed. To operate a mine by water power was the dream of delight of the old-time miner, and when the change to electricity came to those mines which were fortunate in having water power, it was hard to convince the more conservative that their condition was being bettered.

Mines hitherto without cheap power can now be reached by the electric transmission lines which are ever increasing in length. Motor drive has been so perfected that it is applicable to every phase of mining and milling as well as smelting. The winning of metals, though one of the last great industries to adopt this ideal power, is destined to be one of the most satisfactory power loads in this Western country. Many of the problems are analogous to those already solved in other lines of work, so that future progress should be most rapid in this field.

PERSONALS.

Leon M. Hall visited Reno and Virginia City during the past week.

Gano Dunn has been elected president of the American Institute of Electrical Engineers.

Roy C. Fike, of the Home Telephone & Telegraph Company, of Los Angeles, is at San Francisco.

J. Flanagan, an electrical contractor of Stockton, was a San Francisco visitor during the past week.

Geo. Cole, of the John R. Cole Company, has returned to Los Angeles after spending three weeks at Los Angeles.

Marston Campbell, superintendent of public works of the Hawaiian Islands, has arrived at San Francisco for a month's stay.

A. M. Hunt left last week for New York. He will spend about a month in the East in connection with engineering projects.

E. G. Robinson Jr., manager of the Jim Creek Water, Light and Power Company, at Arlington, Wash., is at San Francisco.

E. R. Davis, assistant manager of the Pacific Light & Power Company of Los Angeles, recently spent a few days at San Francisco.

F. B. Gleason, manager of the Western Electric Company's branch, returned to San Francisco last Friday after a trip to Salt Lake City.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company of Chicago, is making a tour of the Pacific Northwest.

Edson F. Adams and W. H. Leffingwell made a trip last week to the site of the Mono Power Company's hydroelectric plant on the Owens River.

Delos A. Chappell, of the Hydroelectric Company, is at Bodie, California, on business connected with the reconstruction of the plant.

Edgar S. Hurley, formerly in the San Francisco department of electricity has been appointed chief electrician of the Geary Street Municipal Electric Railway.

M. F. Orrick, formerly in charge of the telephone sales department of the Western Electric Company at San Francisco, has gone to Salt Lake City to take charge of the company's branch at that point.

John Coffee Hays, general manager of the Mt. Whitney Power Company, and connected with the management of the La Grange Water & Power Company, and other enterprises of John Hays Hammond, is at San Francisco.

P. T. Hanscom has been appointed general superintendent of the Great Western Power Company with headquarters at San Francisco. He was formerly connected with the management of the Central Colorado Power Company.

Horatio A. Foster was in San Francisco this week en route from Los Angeles to the East. As a former classmate and old friend, he was entertained by Samuel H. Taylor of the Electric Railway and Manufacturers' Supply Company.

W. K. Fruedenberger, formerly electrical engineer for the Steptoe Valley Smelting & Mining Co., McGill, Nev., has been appointed engineering expert for the Public Service Commission of Nevada. He has been succeeded by R. E. Middagh.

Mortimer Fleishhacker who is connected with the management of the City Electric Company, left for New York last Thursday to complete the details of the transfer of the Great Western Power Company. The $150,000 option on the City Electric Company expires June 1, and it is expected that in future the Fleishhacker interests will have much to do with shaping the policy of the Great Western system.

TRADE NOTES.

G. A. Wilbur, representative of the Duncan Electric Manufacturing Co., the Triump Electric Co., the Helios Manufacturing Co., et al., has moved from 61 to 78 Second street, San Francisco.

L. E. Sperry, formerly manager of the California Electrical Works (now the Western Electric Co.'s San Francisco house), has established offices and warehouse at 629 Howard street, San Francisco, as the representative of the New York Insulated Wire Company.

J. C. Farrar & Co., Los Angeles, Pacific Coast agents for the Electrical Engineers Equipment Company, have received a large order for the material to be used in wiring the new 100,000 kw. turbo-generator station being built by the Southern California Edison Co.

The General Electric Company has lately shipped to the Southern Power Company a 12,000 ampere triple pole 650 volt a. c. circuit breaker to be used in controlling the current from the 600 volt side of a 11,000/600 volt, 60/40 cycle, 6600 kw. frequency changer set. This is the largest capacity a. c. circuit breaker that has ever been manufactured.

A fire in the factory building of Partrick, Carter & Wilkins Co., Philadelphia, on the night of May the 16th caused considerable damage and a temporary shut down. The loss is being adjusted and arrangements made for an early resumption of work. They ask their friends in the trade to be patient with them for any delays in filling orders as they expect to be in full operation shortly.

The American Electric Fuse Company and the Hygrade Incandescent Lamp Company have arranged with The Northwest Electrical Equipment Company of Portland, Oregon, for representation in that territory. The company will also act as manufacturers' agents for several other specialties, such as overhead material for electric railways, steel transmission towers, electric hammers and tools, underground conduit, wires and cables. The new concern is at 530 Lumber Exchange, and W. H. Barnes, formerly of the J. C. English Company is president and general manager.

The General Electric Company reports the closing of a large contract with the Pacific Electric Railway Company of Los Angeles for electrical machinery and equipment, including the following: Four 2-bearing, motor-generator sets, each consisting of one M. P. C. 8, 1000-kw., 500 r.p.m., 600 v., d.c. generator, direct connected to one A. T. I. 12, 1120 kw., 2200 v., 50 cycle, 3-phase synchronous motor. Three 2-bearing motor-generator sets, each consisting of one M. P. C. 6, 600 kw., 750 r.p.m., 600 v., d.c. generator, direct connected to and mounted on the same base with one I. 8, 900 h.p., 750 r.p.m., 2200 v., 50 cycle, 3-phase induction motor. Fifty quadruple G. E. 210, 60 h.p., 500 v., railway equipments, with G. E. Type M controllers. Nine 450-kw., water-cooled transformers and nine 300-kw., water-cooled transformers, all designed for 15,000 volts for primary and 2250 volts secondary.

NEW CATALOGUES.

Bulletin No. 32R from the Helios Mfg. Co. represented by G. A. Wilbur, 78 Second Street, San Francisco, gives valuable data regarding the "Helios" incandescent series street lighting system.

The Pacific Gas & Electric Company have issued a beautiful 275-page book regarding its properties and territory served, giving the finances, history and statistics of each subsidiary company. It is handsomely illustrated with halftones and contains several maps.

The Westinghouse New Model Roney Mechanical Stoker is illustrated and described in Circular W. M. 504 from The Westinghouse Machine Company. Brief reference is also made to the Westinghouse chain grate stoker and the Westinghouse coal crusher.

ELECTRICAL CONTRACTORS' NOTES.

The National Electric Company of San Francisco has been awarded the wiring contract for the John Swett School.

C. W. Schneider, of the Electrical Supply Company of Sacramento, has been spending a few days at San Francisco.

W. S. Hanbridge, president of the State Electrical Contractors' Association, spent last Thursday at Sacramento and Stockton.

The Butte Electric and Engineering Company of San Francisco has been awarded the contract for wiring, etc., for the Polytechnic High School and adjoining shops.

The Central Electric Company of San Francisco has several large wiring contracts in hand, the larger ones including: The temporary City Hall, $26,500; the Rialto Building, $8000, and twenty buildings for the new artillery barracks at the Presidio, amounting to $10,000.

The Decker Electric Company of San Francisco has almost completed a $75,000 construction contract at the Presidio, including a sub-station and the wiring for the illumination of the buildings, parade grounds and yards.

Possibly the electrical specifications, which were prepared by a New York architect, can be modified so as to reduce the cost considerably. It is understood that about $5000 worth of reflectors were specified for use in the City Council's meeting room. It was not stated whether the object of so much reflection of light was to prevent grafting in the Council or otherwise.

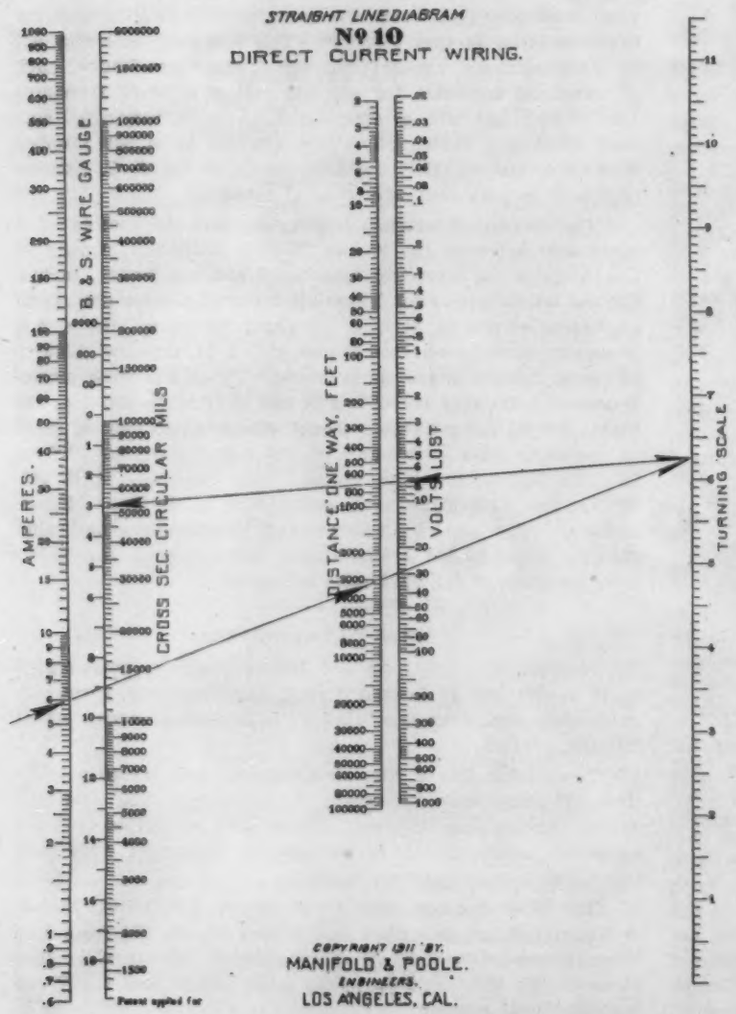
John G. Sutton & Co. of San Francisco were the lowest bidders on the electrical work for the new City Hall at Oakland, their figure being $40,000, as against the highest San Francisco bid of $55,050 by the Pacific Fire Extinguisher Company, and the Eastern bid of $57,000 put in by L. K. Comstock of New York. The other bids were as follows: Butte Electric and Engineering Company, $41,990; Central Electric Company, $48,000; Fell Electric Company, $52,000; Standard Electric Company, $45,750; Newberry, Benheim & Co., $44,800. The very low minimum figure of local bidders and the wide range of other figures, all being below the single Eastern bid, seem to indicate a great anxiety to secure business regardless of profit. It is probable, however, that all of these bids will be rejected and the entire construction work on the City Hall readvertised, for the total of the construction bids filed was $300,000 in excess of the $1,000,000 bond issue.

ELECTRICAL CONTRACTORS MEETING.

The California State Association of Electrical Contractors will meet at Catalina Island during the second week of July. A party of 100 or more will leave San Francisco on July 8 on the Harvard or Yale, a special rate of $10.50 having been made for the round trip. The contractors of Southern California have made big preparations for this event, which is of interest to all in the electrical trades. Full details will be published later or may be obtained directly from W. W. Hanbridge, 68 Post street, San Francisco.

A COMPUTING WIRING DIAGRAM.

The accompanying straight line diagram gives a simple and rapid method of estimating direct current copper wiring. It is used by permission of Manifold & Poole from a forthcoming enlarged edition of their book on "Straight Line Engineering Diagrams."



The diagram is seen to consist of six scales. The first is laid off proportionately to the number of amperes to be carried by the wire, from 0.6 to 100 amperes. The second gives the wire sizes in the B. & S. gauge, while the third gives the corresponding cross section in circular mils. The fourth scale gives the distance one way in feet, the fifth shows the volts lost, while the sixth is merely a turning scale for carrying results forward.

To use the diagram it is merely necessary to connect a known point on one scale to a known point on another, and read the desired result at the intersection of a straight-edge with the intervening scale.

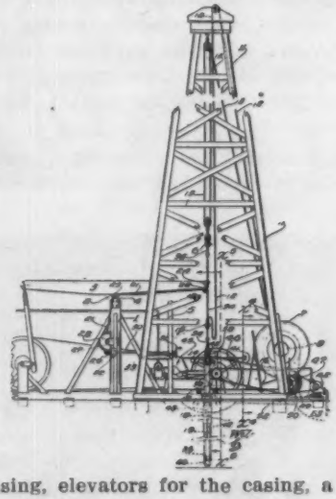
The problem solved by the lines on the diagrams is to find how many volts are lost in transmitting 6 amperes 3000 ft. through No. 3 wire.

A straight-edge passing through 6 on the first scale and 3000 on the fourth scale intersects 6.25 on the sixth scale, this point being used as a pivot to connect to No. 3 on the second scale, thus intersecting 7.5 on the fifth scale, which shows that 7½ volts are lost. If No. 8 wire were used 24 volts would be lost, while with No. 0 wire 3.75 volts would be lost.

Or if the problem were to find how many amperes could be transmitted by No. 3 with a loss of 7½ volts between points 3000 ft. apart the operation would merely be reversed. Similarly, if it were required to find what size of wire is necessary to transmit 6 amperes between points 3000 ft. apart with a volt loss (or drop) of 7½. Other problems are solved in the same manner.

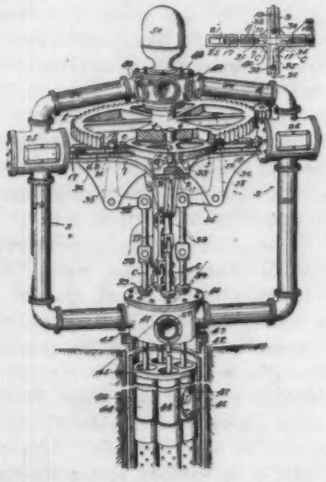
PATENTS

992,527. Combination Standard and Hydraulic Drilling Rig. Wilson B. Wigle, Lompoc, California. In a drilling rig, the combination of a bull wheel, a calf wheel, a pump, a casing line connected with the calf wheel, a casing, a bushing for the casing, a hose-connection between the bushing and the pump, a stuffing-box in the bushing, a line casing extending through the stuffing-box, a drilling line extending through the line casing and connected with the bull wheel, packing for said drilling line



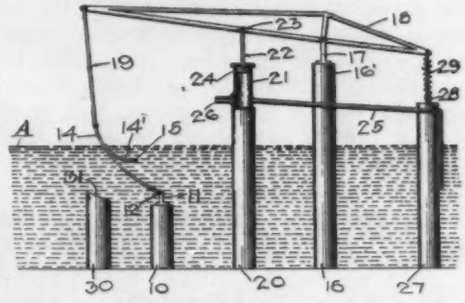
in the line casing, elevators for the casing, a clamp for the drilling line, a walking beam, means for operating the walking beam, pulley means on the walking beam, connections led over the pulley means and connected with the clamp, take-up means for said connections, means under the control of the operator for operating such take-up means, means connecting the elevator with the casing line, a line shaft and clutch connections carried by said line shaft for respectively operating the calf wheel, the pump and the bull wheel.

992,493. Multiple Pump. Stanley L. Fulford, Los Angeles, Cal., assignor of one-fourth to Benjamin Allen Brown, Los Angeles, Cal. The combination of a frame having two crossed guide-ways, two slides arranged to slide in the guide-ways and each provided with studs spaced apart on opposite sides



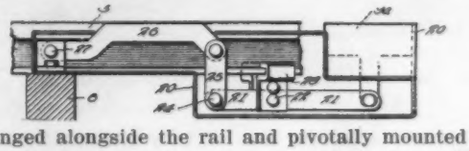
of the intersection of the axes of the slides; a master-wheel journaled on the frame, its axis being at right angles to the slides and alined with said intersection of the slides, a crank-pin on the master-wheel at one side of the axis thereof, a traveling-wheel journaled on the crank-pin and arranged between the studs to engage the studs to slide the slides in their ways, wrist-pins on the slides at opposite sides of said intersection, and bell-cranks pivotally mounted on the frame and operably engaging the wrist-pins.

992,390. Surf-Pump. George W. T. Snare, Ocean Park, Cal. An actuating means for a surf pump comprising a plurality of supports, journals mounted on certain of said supports, a shaft journaled on one set of said supports, a concaved impact element on said shaft and movable therewith,



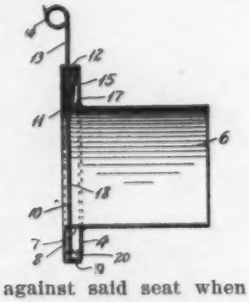
levers mounted in the other of said supports, connections between said levers and said pump, connections between one end of said lever and the impact element, whereby said lever is moved to operate said pump, and means connected to the opposite end of said lever for returning the device to initial position.

992,735. Actuating Mechanism for Station-Indicators or the Like. Orlando E. Kellum and Thatcher P. Wilson, Los Angeles, Cal., assignors to National Street and Station Indicator Company, Los Angeles, Cal. In combination with a rail over which a wheel is adapted to pass, a wheel engaging mem-



ber arranged alongside the rail and pivotally mounted at one end in connection therewith, a clamp secured to the lower edge of the rail, a lever pivoted on the clamp beneath the rail, connection between the free end of the wheel engaging member and one end of the lever, and a movable contact member connected to the other end of the lever.

992,293. Flume-Gate. Elmer O. Thomason, Covina Cal., assignor to Kellar-Thomason Manufacturing Company, Covina, Cal. A gate comprising a tube having a projecting end, a face place having an opening, coinciding with the opening of said tube, said opening having a lip at the edge thereof



adapted to come against said seat when the gate is open, a slide adapted to be forced between said lip and the tube and clamped therebetween, and means for guiding the lower edge of said slide into alinement with the plane of the end of said tube.

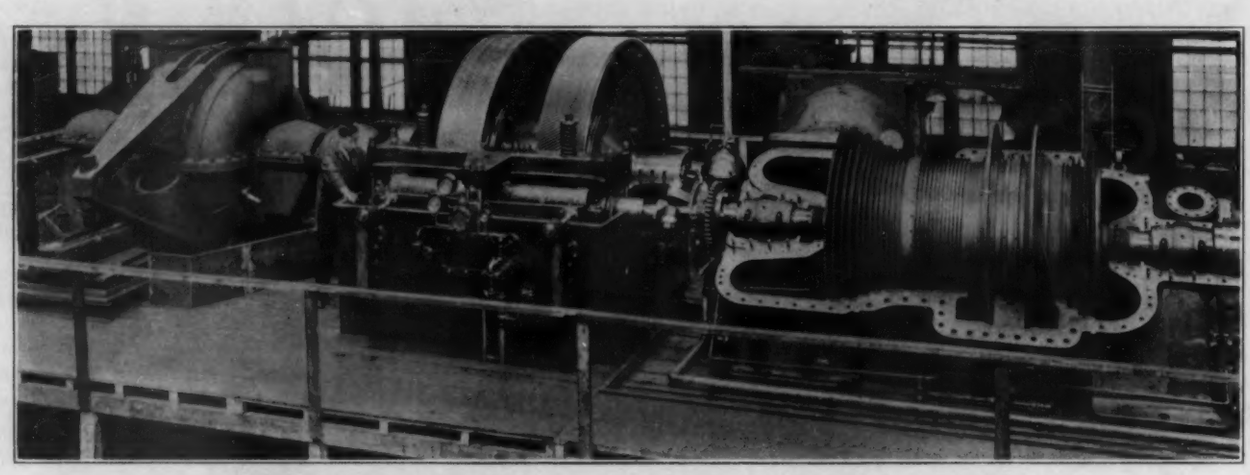
INDUSTRIAL

WESTINGHOUSE MARINE TURBINE AND REDUCTION GEAR INSTALLATION.

Two marine turbines and reduction gears are being installed and shipped by the Westinghouse Machine Company upon U. S. collier "Neptune," a ship of about 19,000 tons. These tests are regarded by naval men as of the highest importance because of the use of comparatively small turbines and reduction gears interposed between their shafts and the propeller shafts, it being claimed that the weight of this class of machinery will be less than half of the weight of other turbines having the propellers coupled direct to the turbine shafts or of reciprocating engines, and that, by reason of the higher speed, the turbines used with reduction gears will require especially for cruising speeds, from 20 to 30 per cent less steam than is now needed by any of the turbine driven ships or ships driven by reciprocating engines.

The upper half of the turbine is arranged so that it can be quickly thrown back upon its hinges in order that all of the blading of the turbine may be quickly inspected. To illustrate the value of this feature to Admirals Betbeder and Garcia of the Argentine Navy and Admiral Cone, Chief Engineer of the U. S. Navy, who have just visited Pittsburgh for a critical inspection of the apparatus, the top cover of the turbine was loosened, removed from its place, the rotor containing the blades given a complete revolution by hand, and the cover restored to its place and the engine again started, all in less than one hour—to be exact, in fifty minutes; this in contrast with several days required to open up and similarly inspect the turbines for one of the screws of a modern battleship.

The reduction gearing has a floating frame for maintaining uniform tooth pressure, but the means for floating the



View of Westinghouse Marine and Reduction Gear with Upper Casting of Turbine and Reduction Gear Removed. The Brake is Shown at Extreme Left.

The design of the turbines adopted has an ahead portion and a reverse portion, and a cruising element, all within one casing. The control mechanism is of an exceedingly simple character and is so arranged that each engine may be run in either direction at any speed up to the maximum, either by mechanism operated in the engine-room or by a duplicate operated from the bridge of the ship, the latter feature being of high importance in the maneuvering of a ship. In fact, the man on the bridge can reverse either or both turbines from full speed ahead to full speed astern in less than fifteen seconds, or in much less time than it now takes to communicate signals from the bridge to the engine-room with other types of control. The speed and direction of both turbines being under instant control, permits of the turning of the ship in the shortest possible distance, and in the event of the steering apparatus being disabled, the ship can be steered and kept to its course by the manipulation of the speed of the turbines. The overspeeding of the turbine engines from any cause whatever, and especially in a heavy sea, is automatically prevented by the governor control. All steam and exhaust connections are made to the lower half of the turbine and the general construction is such that the steam may be turned directly into the apparatus when cold and full speed attained in less than a minute; whereas, the form and dimensions of the turbines which have heretofore been used for naval service have been such that the turbines required pre-heating before starting, such pre-heating taking from three to ten hours, according to the size of the machinery.

pinion frame is of a novel character and not only provides for an elastic motion and a separation of metallic connection between the casing of the pinion and the main casing (which reduces vibration), but at the same time provides an hydraulic dynamometer whereby the exact propeller shaft horsepower being delivered by a turbine, can be read from a gauge. This dynamometer arrangement is mathematically and practically correct and will give advantages in the running of steamships of the very highest importance.

The United States government has already applied a number of turbines for the propulsion of war vessels, and after prolonged tests, the General Board reached a conclusion, which it recently promulgated publicly that no further battleships would be fitted with turbine machinery of the kind that they have so far experimented with. The controlling reason for this decision is the large amount of steam and coal required to propel these ships at cruising speeds with turbines as compared with reciprocating engines.

A demonstration by a trial on the "Neptune" of the practicability of reduction gearing for large horse powers will it is believed change the entire situation with reference to the application of power to naval vessels. The saving of over one-half of the weight in engines and a decrease in the capacity of boilers required because of a less consumption of steam is of the highest importance as it permits of the use of thicker armor and heavier guns.

The turbine and gear equipment being installed upon the "Neptune" represents over five years of study and experi-

mentation under the direction of Mr. Westinghouse in the works of the Westinghouse Machine Company in the development of turbine machinery for the propulsion of ships. The departures from previous practice, which are radical, have been made in the interest of lessening the cost of constuction, facilitating the operation of the machinery and its inspection, and in the reduction of the weight and space occupied, as well as in providing a control mechanism whereby the officer in charge of the ship may, without the intervention of any other person, has as complete a control of the engines as he now has of the steering apparatus.

SMALL DIRECT CURRENT METERS.

A great demand has arisen in recent years for small indicating meters for battery charging installations, small isolated plants, Cooper Hewitt rectifier outfit and similar small installations, which shall have a high degree of accuracy and at the same time be marketable at a price that will not be prohibitive for the service.

To meet this growing demand the Westinghouse Electric & Manufacturing Company, of Pittsburg, a few years ago placed on the market the Type L ammeters and voltmeters, which have recently been improved to such an extent that they are the equal of many higher priced instruments now on the market.

Fig 1.

The meters are 5 inches in diameter, which makes them very convenient for use on small panels. At the same time, the scale is 4 inches and uniformly divided, so that it is fully as legible as some large meters.

The movement of the meters is similar to that of the larger, high grade meters made by the Westinghouse Company. The principle used is the D'Arsonval, or permanent-magnet moving-coil principle, but its application in this case is unique; the magnetic circuit has a single air gap in which the moving coil, moves pivoted at one edge. This arrangement results in several advantages. The single air gap can have larger clearance for the same magnetic strength, making it easy to keep it free from dust or iron filings; the complete moving element can be removed and replaced without disturbing in any way the magnetic circuit or its strength; the entire magnetic circuit can be magnetized, aged and tested as a unit, making variations unlikely.

As shown in Fig. 2, the magnetic circuit is self shielding, and iron cases are not required to protect the instruments from stray magnetic fields.

The moving coil is wound on a light metal frame, the damping effect of which makes the reading dead beat. The frame is carried on especially hardened steel pivots bearing in polished and carefully fitted sapphire jewels. As the coil is pivoted at one edge it acts as a counterbalance for the pointer. This reduces the total weight on the pivots, making friction a minimum and thus tending toward accuracy and long life.

The meter scales are hand calibrated, which eliminates any slight irregularities of the magnetic circuit that may exist. In case of injury to the calibration through overloads, simple adjustments are provided for correction.

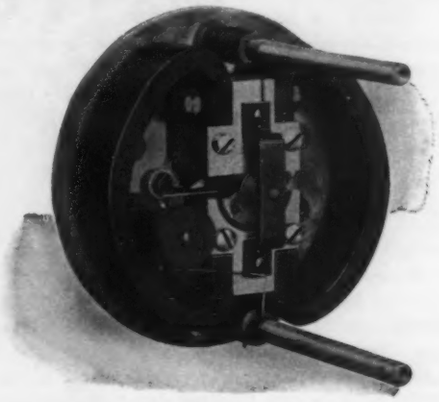


Fig. 2.

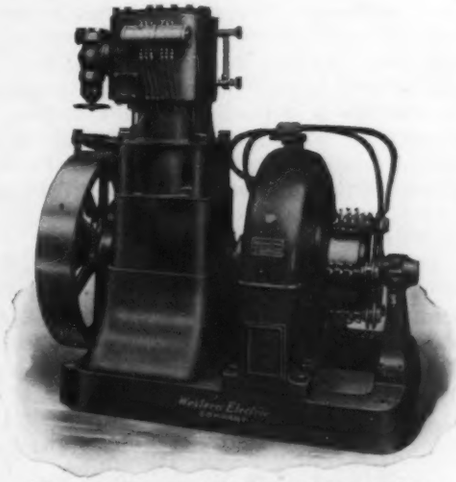
The cases of the meters are of moulded hard rubber, giving the meters a finished appearance. The meters are attached to the panels by means of brass studs which serve also as terminals. Ammeters up to 300 amperes and voltmeters up to 300 volts are listed in the company's catalogue.

WESTERN ELECTRIC STEAM DRIVEN DIRECT CONNECTED GENERATING UNITS.

To meet the demand for a direct connected generating set, especially adapted for power and lighting service in isolated plants or marine installations, and as exciters in large central stations, a new steam driven set has just been placed on the market, known as the "Western Electric" Hawthorn type ML direct connected generating unit.

These sets are furnished with 110 and 125 volt direct current generators, ranging in capacity from 2½ kw. to 75 kw., direct connected to single cylinder or tandem compound, vertical engines which operate condensing or non-condensing at steam pressures of from 35 pounds to 160 pounds.

The engine and generator are assembled on a common cast iron base, which extends the full width of the generator and provides ample base surface for foundation without increase in floor space required.



Western Electric ML Type Steam-Driven Direct-Connected Generating Unit.

The engines are of the vertical marine type so constructed as to insure perfect alignment, balance and adjustment for possible wear. Perfect alignment of the parts is attained by casting the cylinder, valve chest and crosshead guides in one piece, and machining them at a single operation. The piston

rod and cross head and likewise the crank shaft and half coupling are forged from one piece of best machine steel, and by careful and accurate machining of all parts, perfect alignment is further insured. A balanced piston type valve, accurately ground to fit in the steam chest, produces close regulation and freedom from excessive friction. The piston used is equipped with hard cast iron spring rings which effectively prevent leakage of steam. A simple and efficient fly-wheel governor maintains a constant speed by automatically varying the steam admission and compression. This is effected by the motion of the eccentric pin, mounted on a carefully balanced fly-weight which is very sensitive to slight variations in speed. The governor requires very little attention as there are practically no parts subject to wear. The engines are furnished with either the gravity or the forced system of lubrication, and adjustable sight feed tubes allow the regulation of the flow of oil to the various parts.

The generator frame of the smaller sets is cast in one piece of high grade iron. The frame of the large sets is of cast steel and is split horizontally. Soft cast steel poles are rigidly bolted to the frame. The armature is built of high grade sheet steel laminations, pressed on an iron spider and provided with numerous ventilating ducts. Hard drawn copper conductors are form wound and thoroughly insulated with moisture-proof materials before being placed in the slots. The highest grade copper and mica, together with expert workmanship, produce a most reliable and durable commutator. The field coils are very liberally designed, provided with many ventilating ducts and thoroughly insulated. The brush rigging is supported by the bearing, except in the 50 kw. set, on which it is supported by the magnet frame. Individual spring adjustment on the brush holders permits the removal of the brushes for inspection and their return without altering the brush tension.

THE WESTINGHOUSE FORM P2 PORCELAIN STRAIN INSULATOR.

There are many conditions for which properly designed porcelain strain insulators are admirably suited. They are largely used in guy wires by street railway and by electric power companies. Groups in series are used at dead ends to take the strain of and to insulate the line wires.

Westinghouse Form P2 porcelain strain insulators are made of a grade of porcelain much superior to that ordinarily used for such appliances. The glaze is a dark brown so the insulators do not readily attract attention in the air. Sharp corners that would be apt to chip have been avoided and the shape of the grooves is such that the wires lie naturally in them. The dimensions of the three sizes are shown in the accompanying table. The break down voltages when the insulators are dry is about 20,000 volts for each of three sizes. The approximate ultimate tensile strengths of the insulators, when wired up in guy wires, are respectively 14,000 lbs., 16,000 lbs. and 23,000 lbs.

Even if a Westinghouse Form P2 insulator fails either because of excessive stress or through accident, the wires that it carries cannot drop because they are interlinked. Two Form P2 insulators are often installed in series; then if one breaks, the other provides insulation. It is very improbable that two will break at the same time.

Style No.	Form	A	B	C	D	E
138271	C1	2⅝"	3½"	5/16"R	⅜"	15/16"R
138272	C2	2⅝"	3½"	⅜"R	½"	1 1/16"R
138273	C3	3¼"	5¼"	⅜"R	¾"	1¼"R

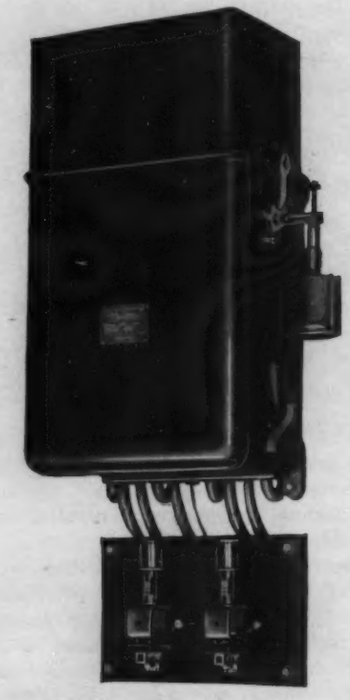
TRADE NOTE.

The C. A. Smith Lumber Company has purchased a Westinghouse 200-kw. belted a.c. generator of the new type. It will furnish current for motors in connection with the extension of the factory at Bay Point for the purpose of making portable houses. A number of Westinghouse motors have also been purchased.

NEW OIL BREAK SWITCH FOR MAN-HOLE SERVICE.

It is oftentimes desirable to install an oil break switch in a man-hole or other location where obviously the ordinary type of oil break switch is not adapted to this service, as there is danger of flooding. To meet this need, the General Electric Company has developed a water-tight oil break switch substantial in construction and suited to operation on circuits up to 7500 volts, in which the normal current rating is 200 amperes, or less.

These switches are made in non-automatic form, single, double and triple pole, single throw. The frame cover and oil vessels are of cast iron and all joints are made water-tight by means of gaskets. The frame is provided with a large vent hole to which a pipe may be connected and extended above the water line to prevent undue strain on the gaskets, due to gases generated when the switches are opened under load. The operating handle is outside the frame and can be operated by hand or by a hook. The shaft to which the handle is attached passes through the frame in a watertight stuffing box. The leads are carried to and from the switch through the bottom of the frame, water-tight bushings being provided for this purpose on the frame.



Single Pole Manhole Switch with Two Outlets.

The double and triple pole switches are so arranged that each lead may pass through a separate outlet, or one outlet may be used in each end of the frame for double or triple conductor cable.

The stationary contacts consist of flared fingers of drop forged copper supported from the contact blocks of the current carrying copper studs by heavy flat steel springs. The studs are supported and insulated from the frame by porcelain insulators. The movable contacts are wedge shaped copper blades actuated by specially treated wooden rods connected to the cross head, which in turn is operated by the handle and actuating mechanism. The construction of the stationary and movable contacts is such that the arc is ruptured between the flared portion of the stationary and the upper extremity of the movable contacts protecting the actual contact surfaces. This form of construction insures clean contact surfaces, uniform contact under pressure, and does not retard the opening of the switch. The General Electric Company's Bulletin 4831 gives detailed information regarding this switch.

NEWS NOTES

FINANCIAL.

LOS ANGELES, CAL.—Certificate of change of principal place of business has been filed by the San Joaquin Light & Power Corporation, from the city of Fresno to the city of Los Angeles.

PENDLETON, ORE.—The city is now authorized to issue bonds to the extent of $200,000 for the purpose of constructing a pipe line from Thorn Hollow Springs at the foot of the Blue mountains to this city, a distance of 18 miles. Two reservoirs are also included in the expense.

TUCUMCARI, N. M.—The citizens have voted that $75,000 bonds be issued, $10,000 of which will be used in improving the present water plant; three miles of new mains will also be laid into the suburban district of the city. A standpipe will be erected and about 65 fire plugs will be installed.

ONTARIO, CAL.—The city has purchased the pipe line of the South Side Water Company for $6000. This will be used in the new municipal water system. The Leeke-Walline system at the north end of the city has also been purchased for $16,000, and this will also become part of the municipal system.

SACRAMENTO, CAL.—The gross earnings of the Sacramento Electric, Gas & Railway Company, a subsidiary company to the Pacific Gas & Electric Company, according to a report made before the State Board of Equalization, were $500,000 for 1910. The company also reported that its earnings—for the Pacific Gas & Electric Company—increased $500,000 during the year, over the earnings of 1909.

ILLUMINATION.

NEWPORT, CAL.—The City Council has passed an ordinance calling a special election for the purpose of submitting the proposition of issuing and selling bonds in the amount of $55,000 for the construction of a municipal light works.

ROSEBURG, ORE.—Bert Sutherland of the Water & Light Company has received a telegram from J. L. Kendall, of Pittsburg, containing instructions to go ahead and install a temporary plant in place of the one recently burned.

CASTLE ROCK, WASH.—The Council has passed an ordinance granting to the Silver Lake Railway & Lumber Company authority to construct and maintain lines for the transmission of electric energy within the limits of the town of Castle Rock.

SANTA ANA, CAL.—The Southern California Edison Electric Company has filed a contract with the Tustin Lighting District for the installation and operation of 110 electric lights on Tustin streets, to be installed by July 15th, and to cost $1.15 per light per month.

PASADENA, CAL.—General Manager Koiner of the electric department estimates the cost of the needed addition of an electrical unit and steam engine at the municipal lighting plant at from $30,000 to $35,000. He states it must be paid for by loaning the department money or by bonding the city for the cost.

SUSANVILLE, CAL.—James Branham has made application to the Board of Trustees for a franchise to construct and maintain poles and wires for the transmission of electricity for heat power and light, along the streets and alleys of Susanville. Sealed bids will be received by the board up to June 1, 1911.

PALO, ALTO, CAL.—The City Council has adopted an ordinance reducing the maximum rates for light and power in Palo Alto. The lighting rate was reduced from 10c to 7½c per kilowatt hour, and the power rate from 5c to 4c. The charge for power for domestic uses was fixed at 3c. The reduction in rates will affect both the municipal lighting plant and the United Gas & Electric Company.

ROSEBURG, ORE.—The W. F. Boardman Company of San Francisco, who were recently awarded a gas franchise in Roseburg, have filed with the city recorder a certified check for $5000 as a guarantee of fulfilling their agreement to install in this city a gas system costing $50,000. Having already secured a site for the gas plant it is expected that they will begin active operations early.

GRANTS PASS, ORE.—A. W. Butler, who has secured a gas franchise here, has purchased from C. E. Phillips and Geo. Barrows a site for the plant. The gas holder to be constructed will have a capacity of 50,000 cubic feet. Generators will have a capacity of 200,000 cubic feet daily. Crude oil will be the material from which gas will be generated. The cost of the plant is estimated at $60,000.

REDDING, CAL.—The Siskiyou Electric Power & Light Company has been granted a franchise by the Board of Supervisors to erect and maintain poles and wires over the roads and highways of Shasta county and upon the streets of unincorporated towns for a period of 50 years. The company's lines now cover Klamath Falls and Ashland, Ore., on the north, and Sisson and Dunsmuir on the south. The company will extend its lines at once to Castella and eventually will work further south, according to President Jesse W. Churchill. The Siskiyou Light & Power Company is now developing 20,000 h.p. and has water enough to develop 40,000 h.p. more.

TRANSMISSION.

VICTORIA, WASH.—This place is calling for bids on furnishing 300 electric light standards for street lighting purposes.

VISALIA, CAL.—The Mount Whitney Power Company will erect a two-story building in West Main street, plans for which have been drawn and accepted.

TACOMA, CAL.—The department of light and water has awarded a contract to the McCormick Lumber Company, McCormick, Wash., for 2500 cross-arms, at $955.

PROSSER, WASH.—The commissioners have granted the Pacific Light & Power Company, a 50-year franchise for the transmission of electric power lines in Benton county.

WALLA WALLA, WASH.—C. S. Walters, manager of the Pacific Power & Light Co., announces that work will soon be started on the construction of a high power transmission between this place and Dayton.

LEAVENWORTH, WASH.—The Snow Creek Water Company, the Icicle Company, and the Tumwater Light & Power Company have made application to the city for a franchise for the exclusive furnishing of water and light.

REDDING, CAL.—A crew of men has commenced work on a 6,000 foot tunnel through the watershed between Cow Creek and Dry Burney Creek. This is the beginning of the Northern California Power Company's great water conservation project, whereby a storage reservoir of 1640 acres will be made by damming Dry Burney Creek. The water is to be caught from the winter floods and stored for the purpose

of generating electrical power will have an average depth of twenty feet. The water will be sufficient to generate 6,000 h.p. at the company's power house.

SEATTLE, WASH.—Plans and specifications for the installation of a steel pipe line from the proposed Lake Union hydroelectric plant at Volunteer park to Lake Union were approved by the Board of Public Works. The specification calls for 2100 ft. of 40-in. pipe and 950 ft. of 36-in. pipe.

QUINCY, CAL.—A notice of appropriation of 50,000 miners' inches of the water of the north fork of the Feather River has been filed in the office of the county recorder by Leroy G. Brown. The purpose of the location is to utilize the water for the generation of electricity at three different points on the stream.

EUGENE, ORE.—The city water board has asked the Council to submit to the people the question of issuing $57,000 in bonds to strengthen and extend the municipal electric plant. The installation of a complete electric distributing system for commercial lights and power and the rehabilitation of the hydroelectric plant at Waterville is contemplated.

GRANGEVILLE, IDAHO.—A number of those who are heavily interested in the Grangeville Light & Power Company are here from Spokane looking over the Ten Mile country with a view to erecting a power plant in that section and furnishing electric power to the mines now operating in that camp and vicinity.

SAN FRANCISCO, CAL.—The Spring Valley Water Company and the Pacific Gas & Electric Company have closed a $100,000 contract for the electric power to be used in building the latter company's Calaveras dam in Alameda county. Already the power company has men in the field preparing for the construction of a power line from Sunol to the Calaveras dam site, a distance of ten miles. The first work will be the sluicing down of the mountain side on each side of the canyon where the 230-foot dam is to be built. When finished it will flood 1200 acres and will be capable of supplying 30,000,000 gallons of water daily, or nearly double the capacity of the present system.

TRANSPORTATION.

LOS ANGELES, CAL.—Contracts for construction work on Glendale-Burbank branch line of the Pacific Electric Railroad have been awarded to Robert Sherer & Co.

SALINAS, CAL.—The Supervisors of San Benito county have declared forfeited the franchise granted to J. C. Kemp Van Ee, in July, 1905, to construct an electric road upon certain highways, because nothing was ever done toward building the road.

RIVERSIDE, CAL.—Representatives of the Pacific Electric Company will shortly appear before the Board of Supervisors and ask for a franchise and right of way between the city limits of Riverside and the Orange county line; 17 miles of track will be required.

SAN JOSE, CAL.—The San Jose Railroad has started its work of standardizing and double tracking its Fourteenth street line with the ultimate view of extending the line to Alum Rock by way of Berryessa. Frank E. Chapin, manager of the San Jose Railroad, denies that the Southern Pacific is behind the Almaden mining men and ranchers promoting a plan for an electric road between this city and New Almaden.

BERKELEY, CAL.—Application for two new street railway franchises were filed with the City Council last week by the Oakland Traction Company. The first application is for an extension of the line up Spruce street to Los Angeles avenue and thence to the Northbrae circle, the second calls for a change in the running of the Grove street cars on Adeline street in South Berkeley. If the proposed change is allowed the Grove street line will cross the Southern Pacific and Key Route railway tracks at a grade crossing at Adeline and Felton streets, running up the west side of Adeline street, to remove congestion of traffic. The franchises will be brought up at the next next meeting of the Council.

FRESNO, CAL.—The actual work of laying ties and rails on the F. S. Granger Railroad will be started on or about the 1st day of next July, according to Mr. Granger. The latest of the grading gangs now at work in the field is to establish a camp about one-half mile north of Lone Star, on what is known as Jensen avenue. With this camp as its headquarters a force of men is now engaged in grading toward Sanger. "If everything goes right," said Mr. Granger, "our railroad will be started in actual operation on December 15th next. The one thing that we are anxious about is that the General Electric Company, which has the contract for the establishment of our power plant, will be through with its work by that time. If we have the electricity, everything else will be ready by the time mentioned.

TELEPHONE.

HANFORD, WASH.—Wheat growers east of this city have organized an association and will construct a telephone line from their district to Mesa, Wash.

MARIPOSA, CAL.—The petition of A. C. Smith and others for the privilege of erecting a telephone line on the Mariposa and Le Grand road, has been granted.

CORNING, CAL.—The Board of Town Trustees at its last meeting granted the franchise asked for by the Tehama Telephone Company, through Joseph P. Tait.

HERMISTON, ORE.—The Farmers' Educational & Co-Operative Union of America are planning a network of telephone lines embracing all towns and surrounding territory of the western half of Umatilla county.

COTTONWOOD, IDAHO.—The Mutual Telephone Company has decided to construct rural telephone lines into Camas and Nez Perce prairies. An appropriation has been made to build a 25-mile line into Joseph plains district.

NEW WESTMINSTER, B. C.—Geo. H. Hales, secretary of the British Columbia Telephone Company, announces that the automatic or central energy telephone systems will be installed here next year. An additional story will be built to the telephone station, and its equipment improved.

WATERWORKS.

LOS ANGELES, CAL.—Samuel L. Walker has applied to the Board of Supervisors for a water franchise covering Baldwin Park and nearby territory.

ALBANY, ORE.—Manager Green of the Oregon Power Company, announces that a $30,000 water system will be put in, work on which will begin at once. It will have the gravity system and be mechanically operated, flushing itself.

EUREKA, CAL.—W. G. Corbaley, superintendent of the Eureka Water Company, who has just returned from San Francisco, states that contracts have been let for the construction of the water tower in southern Eureka. It is estimated that the water tower and tank will cost, all told $30,000.

TACOMA, WASH.—The Council has passed an ordinance providing for the laying of a six-inch iron water main in Local Improvement District No. 575; also providing for the laying of a 12-inch wooden water main on Park avenue from South 72d to South 76th street; a six-inch wooden water main on South 73d, South 74th and South 75th from Park avenue to J street, and on J street from South 72d to South 75th street, according to plans prepared in the office of the Commissioner of Light and Water.